DRAFT

Water Distribution System Master Plan

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City of Grants Pass, Oregon

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WATER DISTRIBUTION SYSTEM MASTER PLAN

FOR

CITY OF GRANTS PASS

FEBRUARY 2016

DRAFT

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SECTION 1
INTRODUCTION AND EXISTING WATER SYSTEM

Introduction

The purpose of this Water Distribution System Master Plan (WDSMP) is to perform an analysis of the City of Grants Pass's (City's) water system and:

- Document water system upgrades, including significant changes in water supply completed since the 2001 *Water Distribution System Master Plan*
- Estimate future water requirements including potential water system expansion areas
- Identify deficiencies and recommend water facility improvements that correct deficiencies and provide for growth
- Update the City's capital improvement program (CIP)

In order to identify system deficiencies, existing water infrastructure inventoried in this section will be assessed based on estimated existing and future water needs developed in **Section 2** and water system performance criteria described in **Section 3**. The results of this analysis are presented in **Section 4**. **Section 5** identifies improvement projects to mitigate existing and projected future deficiencies and provide for system expansion including a prioritized CIP. The planning and analysis efforts presented in this WDSMP are intended to provide the City with the information needed to inform long-term water distribution infrastructure decisions.

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

Related Plans

This WDSMP is consistent with the objectives or information presented in the following related planning and infrastructure documents:

- *Grants Pass Water Distribution System Master Plan*, January 2001, West Yost & Associates.
- City of Grants Pass, *Comprehensive Community Development Plan*, Last amended February 2010.
- *Grants Pass Urban Growth Boundary Amendment*, as approved by the Department of Land Conservation and Development, March 11, 2015.

- *Water Treatment Plant Facility Plan Update*, City of Grants Pass, January 2014, Murray, Smith & Associates, Inc.

- *Water Management and Conservation Plan Update*, City of Grants Pass, June 2014, Murray, Smith & Associates, Inc.

- *Coordinated Population Forecast for Josephine County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2015-2065*, Prepared by Population Research Center, College of Urban and Public Affairs, Portland State University, March 2015

- *Water and Wastewater SCADA Systems Master Plan*, City of Grants Pass, July 2015, Carollo

- *Emergency Operations Plan Update*, City of Grants Pass, 2015, Murray, Smith & Associates, Inc.

Water System Background

The City owns and operates a public water system that supplies potable water to residents, businesses and public institutions within the city limits and a small number of customers in the North Valley area. This section describes the water service area and inventories the City's water system facilities including existing supply sources, pressure zones, finished-water storage reservoirs, pump stations, control valves and distribution piping.

Plate 1 in **Appendix A** illustrates the City's water service area limits, water system facilities and distribution piping.

Service Area

The City's existing water service area includes all existing customers within the Grants Pass city limits and a small area of unincorporated Josephine County five miles north of the City between Merlin and Interstate 5 referred to as the North Valley. The City's water system provides fire suppression to specific areas of North Valley including North Valley Industrial Area (NVIA) and the Paradise Ranch development. **Figure 1-1** at the end of this section illustrates the City's existing water service area.

Conditions of Service

All properties located within the city limits or UGB are eligible for service from the public water system. Water service is provided through a connection to an existing water mainline along the property's frontage or, if there is no existing mainline, by extending a mainline to the property from the City's existing distribution system at the property owner's expense. Residential developments of more than four lots and commercial developments within the UGB are required to extend public water mains and connect to the City's water system.

Smaller residential developments of four lots or less are required to extend mains and connect to City water if they are within 100 feet of an existing City water main.

New customers within the UGB are required to sign a Service and Annexation Agreement which outlines the property owner's rights and obligations as a Grants Pass service customer until the property is annexed by the City. Connection charges are assessed for all new connections to the City water system.

Customers

A number of developed properties within the city limits were historically served by private groundwater wells. Many of these properties, including much of the Fruitdale area in southeast Grants Pass, do not receive City water but continue to be served from private wells. The Rogue Community College campus southwest of the City is also served through private groundwater wells and distribution facilities. For the purpose of this analysis, these properties are not included in the City's existing water service area.

The City water system supplies some Planned Unit Developments (PUDs), such as the Westlake Village and Rogue Lea Estates 55+ manufactured home communities. Homes within each PUD are served through private distribution mains which connect to the City's water system at a single master meter connection.

Supply Facilities

The Grants Pass Water Treatment Plant (WTP) uses conventional filtration to treat surface water drawn from an adjacent intake on the Rogue River. The WTP is the sole source of potable water for the City. Finished water is pumped by the High Service Pump Station from the WTP clearwell into the City's distribution system Pressure Zone 1. The plant typically operates between 8 and 24 hours per day, depending on system demands. During the peak demand months of July through September, the plant is operated for up to 24 hours per day to meet peak day demands. The WTP's current hydraulic capacity is approximately 20 million gallons per day (mgd).

The WTP was built in 1931 with a single sedimentation basin and three filters with a design capacity of approximately 3.5 mgd. The WTP has undergone several upgrades and expansions to serve a growing population and to meet more stringent treatment standards. Capacity upgrades were completed in 1950, 1961, and 1983, and the WTP has received numerous process and safety upgrades over the past three decades

A *WTP Facility Plan Update* (MSA) was completed in 2014 following a structural evaluation of the WTP facilities. The plan analyses found that facility repairs, upgrades and future capacity expansions needed to accommodate anticipated growth were not technically or financially favorable at the current WTP site. The City is pursuing full replacement of the WTP at a new site.

Water Rights

The City holds developed water rights of 19.9 mgd with additional undeveloped rights of 36.7 mgd for a total of 56.6 mgd. The City's undeveloped rights are subject to persistence of fish requirements on the Rogue River. Under low flow conditions at certain times of the year, the City's rights are subject to curtailment as set forth in State issued Extensions of Time for development of these water rights. The City's current water rights are listed in **Table 1-1**.

Table 1-1
Grants Pass Water Rights Summary

Application Number	Permit Number	Certificate Number	Priority Date	Beneficial Use	Permit Rate (cfs)	Developed Rate (cfs)	Undeveloped Rate (cfs)	Status[1]	Current Completion Date
--	--	D15839	1888	Municipal and domestic use, irrigation	12.5	12.5	0.0	NC	--
S34141	S26901	89629	7/19/1960	Municipal use	25	16.95	8.05	NC	--
S41672	S45827	--	12/2/1965	Municipal use	25	0.0	25.0	NC	10/1/2065
S64732	S47346	--	1/13/1983	Municipal use	25	1.3	23.7	NC	10/1/2090
				Total, cfs (mgd)	87.5 (56.6)	30.75 (19.9)	56.75 (36.7)		

Note: 1. "NC" = "not cancelled"

Pressure Zones

The City's existing distribution system is divided into five primary service levels or pressure zones and one sub-zone. Pressure zones are defined by ground topography and their hydraulic grade lines (HGLs) are determined by overflow elevations of water storage facilities, discharge pressures of pump stations or outlet settings of pressure reducing facilities serving the zone.

Due to the City's steep and varied topography, portions of Pressure Zones 2, 3 and 4 are not able to feasibly be connected into a single service area for each zone. As a result, each of these three pressure zones has several hydraulically and geographically independent service areas. For the purposes of this study, each zone service area is designated with both the pressure zone number and a letter code corresponding to the facility serving that area. For instance, the Pressure Zone 2 service area supplied from the Meadow Wood Pump Station is designated 2MW. **Table 1-2** provides a summary of each pressure zone and facilities serving that zone. Pressure zone configurations are illustrated in the existing water system schematic, **Figure 1-2**, at the end of this section.

Table 1-2
Pressure Zone Summary

Zone	HGL (ft)		Elevations Served (ft)	Approx. Service Pressure (psi)	Facilities Supplying the Zone
	Nominal	Operational[1]			
1	1,108.5	1,108.5	900 - 1,020	38 - 90	High Service Pump Station (WTP), Reservoirs 3, 5, 11
2	1,240	1,240	1,020 - 1,140	43 - 95	Lawn Ridge & Madrone Pump Stations, Reservoirs 4, 6
2HT		1,220	1,020 - 1,150	30 - 87	Hilltop Pump Station
2HK		1,210	1,010 - 1,135	32 - 87	Harbeck Pump Station
2NH		1,280	1,010 - 1,150	56 - 117	New Hope Pump Station
2MW		1,250	1,030 - 1,140	48 - 95	Meadow Wood Pump Station
2A	1,150	1,150	985 - 1,025	54 - 71	9th & Savage and Manzanita PRVs
3	1,370	1,370	1,140 - 1,280	39 - 100	Champion Pump Station, Reservoir 8
3MW		1,330	1,140 - 1,290	35 - 82	Meadow Wood Pump Station
3P		1,350	1,040 - 1,220	56 - 134	Panoramic Pump Station
3WX		1,360	1,125 - 1,165	84 - 102	Williams Crossing Pump Station
3S		1,430	1,130 - 1,280	65 - 130	Starlite Pump Station, Starlite PRV
3B	1,340	1,340	1,120 - 1,165	76 - 95	Beacon Dr PRV
4	1,520	1,450-1,500	1,280 - 1,420	35 - 95	Hefley Pump Station, Reservoir 13
4LR		1,510	1,280 - 1,420	39 - 100	Laurel Ridge Pump Station
NV	1,403	1,400	995 - 1,165	102 - 175	Reservoir 15

Note: 1. Operational HGL is the average HGL for each zone based on pump station discharge pressures and reservoir levels recorded by the City's SCADA system for facilities serving each zone.

Storage Reservoirs

The City's water system has eight reservoirs with a total combined storage capacity of approximately 20.53 million gallons (MG). **Table 1-3** presents a summary of the City's existing storage reservoirs. Reservoirs 3, 5 and 11 serving Zone 1 are supplied from the WTP. All other reservoirs are supplied by booster pump stations which monitor the reservoir water level. For multiple reservoirs in a pressure zone, each reservoir is equipped with an altitude valve to control accidental overflows. Reservoirs 3, 5 and 11 serving Zone 1 and Reservoirs 4 and 6 serving Zone 2 have altitude valves installed. Existing City reservoirs are summarized in **Table 1-3**.

Table 1-3
Reservoir Summary

No.	Location	Zone Served	Year Built	Type	Capacity (MG)	Floor Elevation (ft)	Overflow Elevation (ft)
3	500 Block Woodson Dr.	1	2014	concrete	5.0	1,078.5	1,108.5
4	1500 Block Ridge Rd.	2	1953	concrete	0.75	1,216	1,240.0
5	1400 Block Sherman Ln.	1	1983	concrete	3.5	1,079.5	1,108.5
6	2200 Block Crown St.	2	1982	concrete	3.5	1,211	1,240.0
8	Heiglen Loop Rd.	3	1983	concrete	2.0	1,341	1,370.0
11	1420 Denton Trail	1	1999	concrete	4.5	1,078.5	1,108.5
13	1700 Block Sunset Ln.	4	1980	concrete	0.08	1,445	1,455.0
15	3900 Block Highland Ave.	North Valley	1985	concrete	1.3	1,374	1,403.0

Pump Stations

The City operates 13 booster pump stations in addition to the High Service pumps at the WTP. The pump stations serve both open and closed zones. An open zone includes storage reservoirs which are filled by the pump station and serve customers by gravity. Pump stations serving closed zones supply constant pressure to customers without the benefit of gravity storage facilities.

Several of the City's constant pressure pump stations and the High Service pumps at the WTP have variable frequency drives (VFDs). VFDs allow a pump to operate faster or slower in order to provide a wider range of flow rates to meet varying customer water demands. Many of the City's constant pressure pump stations also have pressure tanks. A pressure tank is a small water storage vessel that uses compressed air to maintain a consistent pressure at the tank outlet. As water flows out of the tank to customers the pressure in the tank drops which signals pumps to refill the tank. Both VFDs and pressure tanks are used to maintain consistent service pressure to customers under low demand conditions while minimizing pump cycling on and off which reduces wear and equipment maintenance. **Table 1-4** summarizes the City's existing pump stations.

Table 1-4
Pump Station Summary

Pump Station	Pressure Zone	Serves	No. of Pumps	Nominal Capacity (gpm)	VFD	Pressure Tank
High Service Pump Station (Water Treatment Plant)	1	Reservoirs 3, 5 & 11	6	20,100	Yes	No
Lawnridge	2	Reservoir 6	4	4,400	No	No
Madrone	2	Reservoir 4	3	2,690	No	No
Harbeck	2HK	Constant Pressure	3	1,368	Yes	No
Hilltop	2HT	Constant Pressure	7	2,480	Yes	Yes
New Hope	2NH	Constant Pressure	6	3,156	Yes	Yes
Meadow Wood	2MW	Constant Pressure	3	1,700	Yes	Yes
	3MW	Constant Pressure	3	1,053	Yes	Yes
Champion	3	Reservoir 8	3	4,700	No	No
Starlite	3S	Constant Pressure	5	1,698	Yes	Yes
Laurel Ridge	4LR	Constant Pressure	4	1,816	Yes	Yes
Williams Crossing	3WX	Constant Pressure	2	140	No	Yes
Panoramic Loop	3P	Constant Pressure	4	2,220	Yes	Yes
Hefley	4	Reservoir 13	4	1,758	No	No
North Valley	NV	Reservoir 15	3	1,070	No	Yes

Control Valves

The City's distribution system includes several pressure reducing valves (PRVs) that are used for one of two primary purposes:

1. To provide supply to customers in Zone 2A or 3B. PRVs are the only facilities providing service pressure to these zones. These PRVs generally have parallel valves, a smaller 2-inch diameter valve for lower demands and a larger 6- or 8-inch diameter valve to serve larger demands and fire flow.

2. To provide backup supply from a higher elevation zone

Table 1-5 summarizes the City's PRVs.

Table 1-5
PRV Summary

Location	Zone From	Zone To	Size (in)	Pressure Setting (psi)	Service
Meadow Wood PS	3MW	2MW	2	82	Backup
			6	75	
1025 NW Starlite Place	4LR	3S	2	60	Backup
			6	55	
NE Savage St & NE 9th St	2	2A	10	54	Supply
NW Manzanita Ave & NW Hawthorne Ave	2	2A	6	72	Supply
1316 NE Beacon Drive	4	3B	6	80	Supply

Distribution Piping

The City's distribution piping includes various pipe materials in sizes up to 36 inches in diameter. The total length of piping in the service area is approximately 192 miles. Pipe material documentation is not readily available for much of the distribution piping, but is understood to be mostly cast iron and ductile iron. **Table 1-6** presents a summary of pipe lengths by diameter.

Table 1-6
Distribution Piping Summary

Diameter (in)	Approx. Length (miles)
2	2.7
4	1.5
6	44.3
8	77.1
10	8.1
12	36.1
14	0.4
16	11.7
20	3.6
24	1.0
30	1.0
36	0.01
Total Length	**187.5**

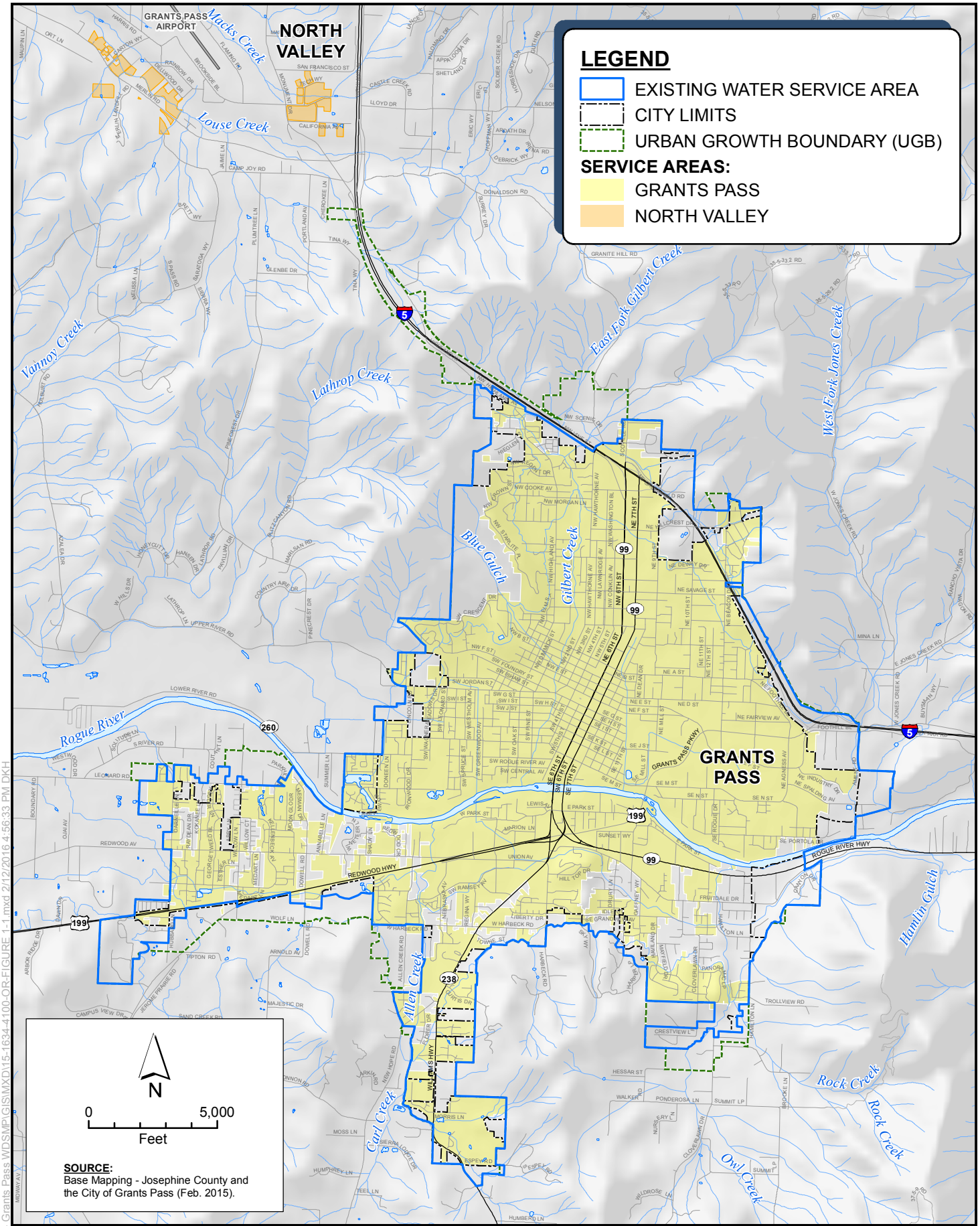
SCADA System

The City's supervisory control and data acquisition (SCADA) system monitors all storage reservoirs and pump stations within the City's water distribution system and provides for manual or automatic control of certain facilities and operations. The SCADA system also collects and stores system status and performance data.

All facilities are equipped with remote telemetry units (RTUs) that monitor reservoir water levels, pump station on/off status, discharge pressure and flow rates. In addition, some sites are equipped with intrusion, overflow warning and fire alarms which alert staff to unauthorized access, flooding or fire. All signals from the RTUs are collected and transmitted to a computer terminal at the WTP which enables City staff to view the status of the water system. More detailed information regarding the City's SCADA system is provided in the 2015 *Water and Wastewater SCADA Systems Master Plan* (Carollo).

Summary

This section presents a summary of the City's existing water system, including service area, supply facilities, pressure zones, storage and pumping facilities, control valves and distribution system piping.



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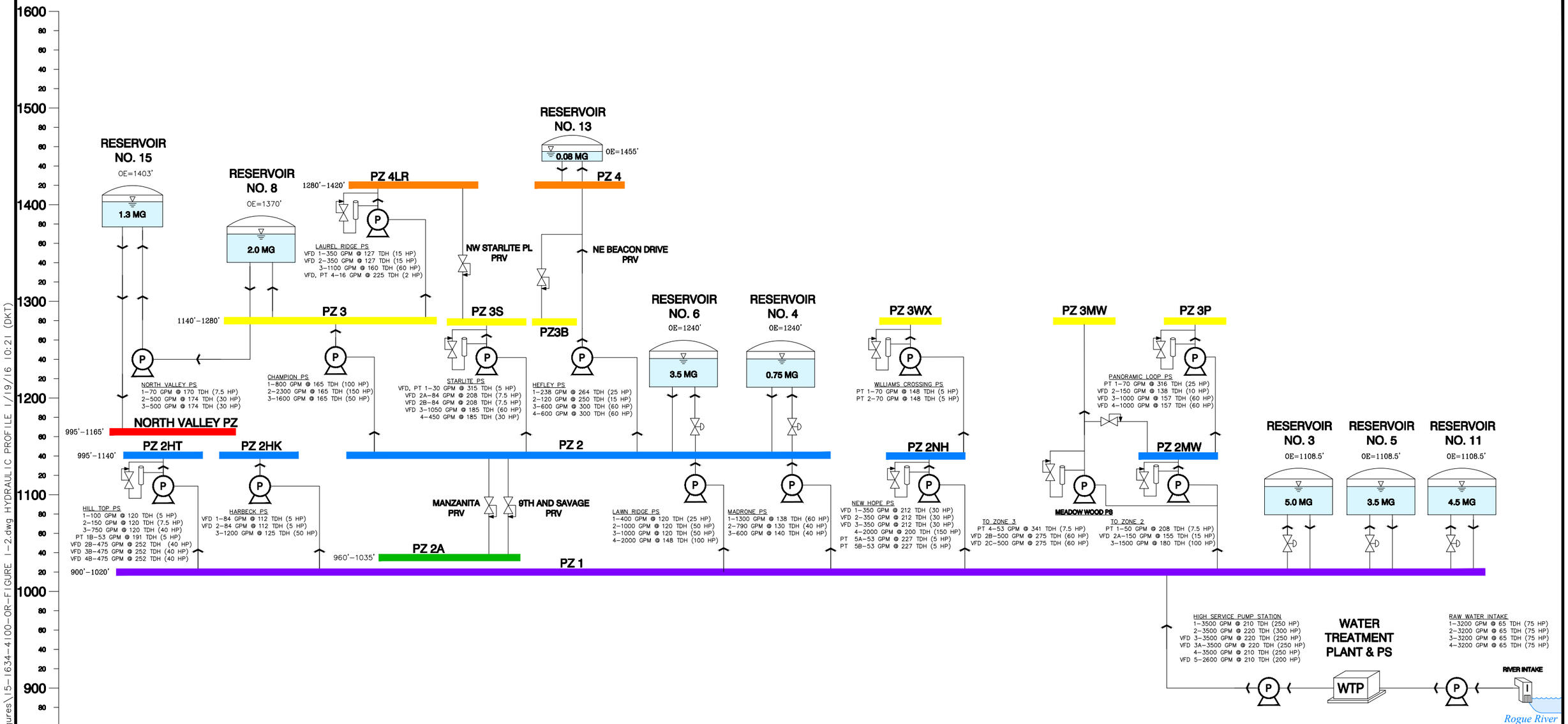
Murray, Smith & Associates, Inc.

Water Distribution System Master Plan

Figure 1-1
Existing Water System Service Area



LEGEND

- WATER MAIN
- HIGHEST GROUND ELEVATION SERVED BY PRESSURE ZONE OR SUBZONE
- RESERVOIR (1.0 MG, OE=1240', OVERFLOW ELEVATION, CAPACITY)
- ALTITUDE VALVE
- PRESSURE REDUCING VALVE
- PRESSURE TANK
- PUMP STATION

ABBREVIATIONS

EL	ELEVATION
GPM	GALLONS PER MINUTE
HP	HORSEPOWER
MG	MILLION GALLONS
OE	OVERFLOW ELEVATION
PRV	PRESSURE REDUCING VALVE
PS	PUMP STATION
PT	PRESSURE TANK
PZ	PRESSURE ZONE
TDH	TOTAL DYNAMIC HEAD
VFD	VARIABLE FREQUENCY (SPEED) DRIVE

DATA SOURCE: JASON CANADY - CITY OF GRANTS PASS WATER TREATMENT PLANT SUPERVISOR, MARCH 2015.

FIGURE 1-2

CITY OF GRANTS PASS

Water Distribution System Master Plan

Existing Water System Schematic

February 2016

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15-1634

G:\PDX_Projects\15\1634 - Grants Pass WDSMP\CAD\Figures\15-1634-4100-OR-FIGURE 1-2.dwg HYDRAULIC PROFILE 1/19/16 10:21 (DKT)

SECTION 2
WATER REQUIREMENTS

This section presents existing and projected future water demands for the City of Grants Pass's (City's) water service area.

Service Area

The water service area is the specific area within which direct water service is currently available. For cities that provide water service to their residents, the area is typically the city limits and can be expected to grow in the future as property is annexed within the Urban Growth Boundary (UGB) and as the UGB is expanded. A description of the existing and future service area boundaries used for the analyses follows. Service area boundaries are illustrated on **Figure 2-1** at the end of this section.

Existing

The City's existing water service area includes all existing water customers within the Grants Pass city limits and a small area of unincorporated Josephine County five miles north of the City between Merlin and Interstate 5 referred to as the North Valley. A number of developed properties within the city limits are supplied drinking water by private groundwater wells and do not receive City water. These properties are not included in the existing service area.

Future

The future water service area includes the entire area within the city limits and UGB as well as North Valley. Future North Valley customers are described in more detail later in this section. For the purposes of this Water Distribution System Master Plan (WDSMP) it is assumed that existing developed properties within the UGB which are supplied by private wells will not be included in the water system service area through the 20-year planning horizon. These properties are assumed to connect to the City water system beyond the 20-year planning horizon and are included in the future service area at saturation development. These assumptions regarding private well customers facilitate long-term planning for future water system capacity. They are not intended to establish a City policy for these customers. For this analysis, it is assumed that all new development within the UGB will receive City water service.

Future water service expansion areas are divided between existing and proposed future pressure zones based on ground elevations and a service pressure range of 35 to 80 pounds per square inch (psi). Grants Pass's existing and proposed future pressure zones are illustrated on **Figure 2-2** at the end of this section and discussed in further detail in **Section 4**.

Planning Period

The planning period for this WDSMP is 20 years, through the year 2036, consistent with Oregon Administrative Rule (OAR) requirements for Water System Master Plans (OAR 333-061). Although not required for regulatory approval, water demand projections are also provided for a 30-year window consistent with the City's comprehensive planning process.

Some planning and facility sizing efforts within this WDSMP will use estimates of water demands at saturation development. Saturation development occurs when all the vacant, developable land within the planning area has been developed to the maximum zoning density with some practical allowance for in-fill of existing developed properties. For the purposes of this WDSMP, saturation development is assumed to occur at 30 years. Typically, if substantial water system improvements are required beyond the 20-year planning period in order to accommodate water demands at saturation development, staging is recommended for facilities where incremental expansion is feasible and practical.

Current Water Demand

Water demand refers to all water required by the system including residential, commercial, industrial and institutional uses. Demands are described using three water use metrics, average daily demand (ADD), maximum day demand (MDD) and peak hour demand (PHD), in gallons per unit of time such as gallons per day (gpd) or million gallons per day (mgd). ADD is the total annual water volume used system-wide divided by 365 days per year. MDD is the largest 24-hour water volume for a given year. In western Oregon, MDD usually occurs each year between July 1st and September 30th. This timeframe is referred to as the peak season. PHD is estimated as the largest hour of demand on the maximum water use day.

Water demand can be calculated using either water consumption or water production data. Water consumption data is taken from the City's customer billing records and includes all revenue metered uses. Water production is measured as the water supplied to the distribution system from the City's Water Treatment Plant (WTP) plus the water volume supplied from distribution storage. Water production includes unaccounted-for water including water loss and unmetered, non-revenue uses, such as, hydrant flushing.

For the purposes of this WDSMP, water production data is used to calculate total water demand in order to account for unmetered water uses. 2014 customer consumption and billing records are used to distribute demands throughout the water system hydraulic model, discussed in **Section 4**, and to estimate water demand distribution among the City's pressure zones.

The historical ratios of MDD:ADD and PHD:MDD are used to estimate future maximum day and peak hour demands. Based on historical system-wide demands, the ratio of MDD:ADD is approximately 2.1. The ratio of PHD:MDD is approximately 1.7 consistent with similar regional water providers. Due to inconsistent or unavailable historical flow data

from the City's other constant pressure pump stations, the ratio of PHD:MDD is estimated based on historical flow data from the New Hope Pump Station. **Table 2-1** summarizes the City's current system-wide water demand based on water production data.

Table 2-1
Current Water Demand Summary

Year	ADD (mgd)	MDD (mgd)
2009	5.55	12.27
2010	5.17	11.96
2011	4.99	10.12
2012	5.28	11.10
2013	5.38	11.44
2014	5.51	11.24

Water Demand by Pressure Zone

As described in Section 1, water systems are divided into pressure zones in order to provide adequate service pressure to customers at different elevations. Each pressure zone is served by specific facilities, such as, reservoirs or pump stations and related piping which supply pressure to customers. In order to assess the adequacy of these facilities, it is necessary to estimate demand in each pressure zone. Current water demand based on WTP production and stored water volume data presented in **Table 2-1** is distributed between the City's pressure zones based on metered water consumption from 2014 billing records. Current water demand by pressure zone is summarized in **Table 2-2**.

Table 2-2
Current (2014) Water Demand by Pressure Zone

Pressure Zone	ADD (mgd)	MDD (mgd)	Percentage of Total Demand
1	3.81	7.77	69.11%
2	0.64	1.31	11.67%
2A	0.22	0.46	4.05%
2HK	0.01	0.02	0.19%
2HT	0.01	0.02	0.14%
2MW	0.07	0.14	1.26%
2NH	0.07	0.15	1.34%
3	0.55	1.12	9.93%
3MW	0.001	0.001	0.01%
3P	0.01	0.01	0.13%
3S	0.01	0.01	0.13%
3WX	0.003	0.01	0.06%
4[1]	0.06	0.12	1.08%
4LR	0.02	0.05	0.44%
NV	0.03	0.05	0.47%
Total	**5.51**	**11.24**	**100%**

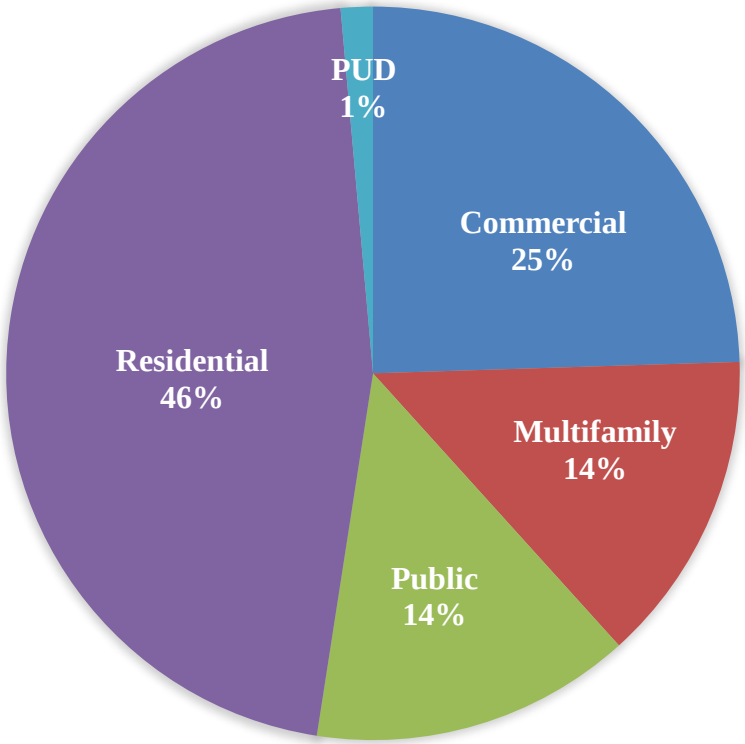
Note:
1. Pressure zone 4 demands include small demand for Zone 3B along Beacon Drive which is served through a PRV from Hefley Pump Station.

Water Consumption by Customer Type

Current water consumption by rate class or customer type from the City's billing records is used to correlate water demand to land use type for future demand projections. The City's water utility billing records maintain five rate classes; Residential, Multifamily, Commercial, Public and Residential Planned Unit Development (PUD). PUD customers serve several homes from a single master meter connection to City distribution mains. Current water consumption by rate class is based on 2014 City water billing data as illustrated in **Figure 2-3**.

In addition to the rate class, the City also uses a service type indicator which is either domestic water service, irrigation service or standby. Standby meters are intended to be used only in an emergency. Grants Pass's irrigation consumption serves both residential and non-residential properties. The total water consumption for all service types is used to estimate future water demands by customer type.

Figure 2-3
Current Annual Water Consumption by Customer Type



Equivalent Residential Units (ERUs)

The Grants Pass water system serves single-family residential customers as well as commercial customers and multifamily housing developments. Single-family residential water services generally have a consistent daily and seasonal pattern of water use or demand. Water demands for multifamily residences, commercial and industrial users may vary from service to service depending on the density of multifamily developments or the type of commercial enterprise. In order to establish a common measure of water demand growth for all customer types, the water needs of non-residential and multifamily residential customers are represented by comparing their water use volume to the average single-family residential unit water use. The number of single-family residential units that could be served by the water demand of these other types of customers is referred to as a number of "equivalent residential units" (ERUs).

ERUs differ from actual metered water service connections in that they relate all water customers to an equivalent number of representative single-family residential customers based on typical annual consumption. ERUs calculated here are specific to estimating future water demand and are not the same as dwelling units used in housing studies or comprehensive planning to forecast future population.

Average Daily Water Demand per ERU

ADD per ERU is calculated from City billing records as the 2014 average daily consumption by single-family residential customers divided by the number of single-family residential meter records. As previously discussed, average daily consumption reflects both domestic and irrigation water use. Current ADD per ERU is approximately 322 gallons per day (gpd/ERU) as summarized in **Table 2-3**. For the purposes of this analysis, ADD per ERU is assumed to remain constant in the future.

Table 2-3
ADD per ERU

2014 Residential[1] Water Consumption (gallons)	919,861,976
Residential Consumption ADD (gallons)	2,520,170
No. of Single-Family Residential Customers	7,836
ADD per ERU (gpd/ERU)	**322**

Notes:

1. *Residential consumption and number of customers includes all meters with 2014 billing records and a rate class of "R" excluding PUDs and condominium developments with common open space.*

Planned Unit Developments

Although many of the customers served through PUD master meters are residing in developments of single-family attached or detached homes like condominiums and mobile home parks, the water consumption of these developments more closely resembles customers in the Multifamily water rate class. Existing Grants Pass PUDs incorporate common green space or community facilities which are served by the City water system similar to existing multifamily developments within the City. For the purposes of this analysis, water consumption by customers in PUDs and condominiums are included in the Multifamily customer type.

ERUs per Acre

Future ADD projections are based on the anticipated number of ERUs per acre for each land use category and the number of developable acres in each category from the City's *Comprehensive Plan 2014 Update*. Single-family residential ERUs per acre are estimated based on the average demand per acre for existing residential customers in the Low Density and Moderate Density Residential land use categories.

ERUs per acre for multifamily, PUD and non-residential developments in the City's water service area are estimated based on 2014 water billing records for existing customers, parcel area associated with each of these billing records and a demand per ERU of 322 gpd. Estimated ERUs per acre are summarized in **Table 2-4**.

Table 2-4
ERUs per Acre

Land Use Category	Comprehensive Plan Designation and City Zoning	ERUs per acre
Low Density Residential	LR: R-1-12, R-1-10, R-1-8	4.2
Moderate Density Residential	MR: R-1-6, R-2	5.4
MultiFamily (PUD)	Moderate-High and High Density Residential (HR & HRR): R-3, R-3-1, R-3-2, R-4, R-4-1, R-4-2, R-5	6.9
Commercial	Neighborhood Commercial (NC), River Tourist Commercial (RTC), General Commercial (GC), Central Business District (CBD)	6.0
Employment (Industrial)	Business Park (BP), Industrial Park (IP), Industrial (I)	3.3
Parks	-	6.0

Future Water Demand Projections

Estimates of future growth and related water demand are developed using the best available information for the City's service area including geographic information system (GIS) data, the Population Research Center's (PRC's) June 2015 *Coordinated Population Forecast for Josephine County*, buildable lands inventory from the City's *Comprehensive Plan 2014 Update* and current water demand data presented earlier in this section. Future system-wide water demands are forecast at 10-years, 20-years and at saturation development. For the purposes of this WDSMP, saturation development is assumed to occur at 30 years.

Estimated water demands at saturation development are used to size recommended transmission and distribution improvements to accommodate ultimate capacity needs. Future MDD is projected from estimated future ADD based on the current average ratio of MDD:ADD, also referred to as a peaking factor. From current water demand data shown in **Table 2-1**, the MDD:ADD peaking factor for the Grants Pass system is approximately 2.1. Future PHD is similarly projected from future MDD, the PHD:MDD peaking factor is approximately 1.7.

Forecast demands are allocated to existing and proposed future pressure zones based on the ground elevations in water service expansion areas and a service pressure range of 35 to 80 psi. Existing and proposed pressure zone boundaries for the study area are illustrated on **Figure 2-2** at the end of this section. Projected demands are summarized in **Table 2-7** at the end of this section.

Within UGB

10-Year Water Demand Projection

Water demand at 10 years is forecast based on anticipated growth rates for the Grants Pass UGB published in the PRC's *June 2015 Population Forecast for Josephine County*. As shown in **Figure 2-3**, the majority of water use within the City's service area is by residential customers thus short-term water demand growth may be reasonably estimated based on projected population growth rates.

The PRC's *June 2015 Population Forecast for Josephine County* shows a projected annual average growth rate of 1.5 percent for the Grants Pass UGB through 2035. Projected 10-year water demands are assumed to be distributed to existing pressure zones based on the percentage of existing demand in each zone as presented in **Table 2-2**.

20-Year and Saturation (30-Year) Water Demand Projections

The Grants Pass *Comprehensive Plan 2014 Update* Figure 5-2 includes an inventory of developable acreage within the UGB and Urban Reserve Areas (URA) for residential and non-residential land use categories at 20 and 30 years. Water demand growth at 20 years and saturation development (30 years) is projected based on this developable acreage and the ERUs per acre presented in **Table 2-3**. Projected 20- and 30-year water demands are distributed to existing and proposed future pressure zones based on GIS mapping of buildable lands, the 2014 UGB expansion and URAs.

<u>Private Well Customers</u>

It is assumed that residents within the UGB currently served by private wells or small private water systems will continue to receive water outside the City system through 20 years. All new development within the UGB is assumed to be served by the City water system with no newly developed properties being served by private wells. Water demand forecasts at saturation development (30 years) assume that all existing private customers will be connected to the City water system.

These assumptions regarding private well customers facilitate long-term planning for future water system capacity, they are not intended to establish a City policy for these potential customers. Water demands for residents currently served by private wells and water systems are estimated based on the number of ERUs per acre for each development type as shown in **Table 2-3**. Existing developed properties within the City's water service area that are not

currently served by the City's water system are estimated to contribute approximately 1.3 mgd to average daily demands at saturation development.

Rogue Community College

Rogue Community College's (RCC) 80-acre Redwood Campus is located in the southwestern corner of the Grants Pass UGB. The campus is currently supplied through a private water distribution system with a dedicated groundwater source, treatment and finished water storage reservoirs. RCC's Redwood Campus includes approximately 30 developed acres including one and two-story classroom buildings, a gymnasium, irrigated sports fields and café.

For the purposes of this analysis, it is assumed that RCC may receive water service from the City within the 30-year planning horizon. Potential RCC water demand is estimated as 30 acres at approximately 6.0 ERUs per acre consistent with average demand per acre for existing commercial development in Grants Pass.

North Valley

The City currently serves three groups of customers within the North Valley water service area:

1. North Valley Industrial Area (NVIA)
2. Merlin Landfill area
3. Paradise Ranch

It is anticipated that the City will continue to serve existing customers and some growth in these three areas as well as a portion of the 2014 UGB expansion north of the existing North Valley Reservoir.

NVIA

The NVIA was the catalyst for construction of Reservoir 15 by Josephine County and creation of the North Valley Pressure Zone when the City assumed ownership and management of the reservoir. The ultimate ADD for the NVIA's 90-acre water service area was estimated at 40,000 gpd (0.04 mgd) in the 1982 *NVIA Water and Wastewater Analysis Phase 1*. This build-out estimate is based on approximately 80 acres of industrial development at approximately 500 gpd/acre (1.6 ERUs/acre). The remaining 10 acres are assumed to be devoted to right-of-way consistent with existing roadways within the NVIA.

The 1982 study assumed future industrial development in this area would have low water demand characteristics. Current billing records for customers in the NVIA indicate ADD/acre is well below 500 gpd/acre. For the purposes of this analysis, it is assumed that NVIA ADD will increase by a total of 0.01 mgd in 10-years, 0.02 mgd in 20-years and reach an ultimate demand of 0.04 mgd at 30-years consistent with the 1982 study.

Merlin Landfill Area

In the 1990s, the Merlin Landfill in the North Valley area was determined to be a potential source of groundwater contamination. Part of the mitigation strategy for this potential contamination was to discontinue pumping at identified private wells adjacent to the landfill along Merlin Road. The City currently supplies water to these private well owners.

Of the 75 properties eligible to connect to the City water system due to potential contamination, 48 properties are currently connected. For the purposes of this analysis, it is assumed that, of the remaining 27 properties, four will remain undeveloped and 23 will be connected to the City water system within 30 years, with 11 connected within 10 years and 17 at 20 years. Existing land development in this area is primarily rural residential. Based on 2014 water meter records for this area, it is assumed that each property connected will demand approximately 2 ERUs (ADD of 644 gpd) of water.

Fire service in the North Valley area is provided by the Rural/Metro Fire Department. The City does not provide water for fire suppression on the north side Merlin Road where there are no City fire hydrants. Fire hydrants and capacity for fire suppression is provided on the landfill property.

Paradise Ranch

Paradise Ranch Resort, located on the west side of Monument Drive near the North Valley High School, was designed to be a destination resort with overnight accommodations, restaurants, convention and entertainment facilities as well as residential home sites. In 2005, the resort developer established agreements with the City for municipal water service to supply all domestic demands on the resort property as well as limited interruptible golf course irrigation and water for fire protection. Water system facilities connecting the resort to the City's existing distribution system were constructed by the resort developer to meet City standards. Due to developer financial issues, resort construction was halted in 2010. Currently, the City does not provide water to any active services on the Paradise Ranch property.

The 2004 technical memorandum *Paradise Ranch – Water System Extension Alternative Analysis* (West Yost) estimated MDD for Paradise Ranch based on anticipated development. ADD for Paradise Ranch is calculated based on a peaking factor of 2.2 documented in this 2004 tech memo. Paradise Ranch demand estimates are summarized in **Table 2-5**. The timeline for any future development at Paradise Ranch is currently unknown. For the purposes of this analysis it is assumed that the golf course water demand will be fully developed within 10 years along with half of the commercial and residential demand. The remaining estimated water demand is assumed to be fully developed within 20 years.

Table 2-5
Paradise Ranch Future Water Demand

Paradise Ranch Development Type	10-Year		20- & 30-Year (saturation)	
	ADD (mgd)	MDD (mgd)	ADD (mgd)	MDD (mgd)
Residential Home Sites	0.03	0.06	0.05	0.12
Commercial Facilities	0.03	0.06	0.06	0.13
Golf Course	0.59	1.30	0.59	1.30
TOTAL	**0.65**	**1.42**	**0.70**	**1.55**

Future Monument Drive Customers

As part of the Monument Drive 16-inch diameter main construction, tee fittings were included at cross streets to facilitate potential future City water customers along the line south of Paradise Ranch. The 2004 technical memorandum *Paradise Ranch – Water System Extension Alternative Analysis* (West Yost) established estimated demands for these potential customers which are not included in this analysis.

North Valley Service Area Summary

Current and estimated future water demands for the North Valley Area are summarized in **Table 2-6**.

Table 2-6
North Valley Water Demand

North Valley Sub-Area	Current		10-year		20-year		30-year	
	ADD (mgd)	MDD (mgd)	ADD (mgd)	MDD (mgd)	ADD (mgd)	MDD (mgd)	ADD (mgd)	MDD (mgd)
NVIA	0.001	0.0021	0.011	0.0231	0.021	0.0441	0.041	0.0861
Merlin Landfill	0.029	0.048	0.055	0.115	0.059	0.124	0.063	0.132
Paradise Ranch	-	-	0.65	1.42	0.70	1.55	0.70	1.55
2014 UGB Expansion	-	-	-	-	0.027	0.056	0.027	0.056
TOTAL	**0.03**	**0.05**	**0.72**	**1.56**	**0.81**	**1.77**	**0.83**	**1.82**

Table 2-7
Future Water Demand by Pressure Zone

Pressure Zone	10-Year				20-Year				Saturation (30-Year)			
	ERUs	ADD	MDD	PHD	ERUs	ADD	MDD	PHD	ERUs	ADD	MDD	PHD
1	14,068	4.53	9.51	16.17	16,894	5.44	11.42	19.41	22,112	7.12	14.95	25.42
1RR	-	-	-	-	-	-	-	-	12	0.004	0.01	0.02
2	2,360	0.76	1.60	2.72	2,484	0.80	1.68	2.86	2,547	0.82	1.72	2.92
2A	839	0.27	0.57	0.97	839	0.27	0.57	0.97	839	0.27	0.57	0.97
2FD	-	-	-	-	62	0.02	0.04	0.07	62	0.02	0.04	0.07
2HK	31	0.01	0.02	0.03	31	0.01	0.02	0.03	62	0.02	0.04	0.07
2HT	31	0.01	0.02	0.03	62	0.02	0.04	0.07	62	0.02	0.04	0.07
2MW	248	0.08	0.17	0.29	745	0.24	0.50	0.85	1,087	0.35	0.74	1.26
2NH	280	0.09	0.19	0.32	714	0.23	0.48	0.82	901	0.29	0.61	1.04
2SW	-	-	-	-	12	0.004	0.01	0.02	12	0.004	0.01	0.02
3	2,019	0.65	1.37	2.33	2,329	0.75	1.58	2.69	2,578	0.83	1.74	2.96
3BG	-	-	-	-	217	0.07	0.15	0.26	217	0.07	0.15	0.26
3MW	3	0.001	0.002	0.003	127	0.04	0.09	0.15	127	0.04	0.09	0.15
3P	31	0.01	0.02	0.03	31	0.01	0.02	0.03	31	0.01	0.02	0.03
3S	31	0.01	0.02	0.03	31	0.01	0.02	0.03	31	0.01	0.02	0.03
3SE	-	-	-	-	6	0.002	0.004	0.007	224	0.07	0.15	0.26
3WX	12	0.004	0.01	0.02	12	0.004	0.01	0.02	12	0.004	0.01	0.02
4	217	0.07	0.15	0.26	404	0.13	0.27	0.46	497	0.16	0.34	0.58
4GH	-	-	-	-	12	0.004	0.01	0.02	12	0.004	0.01	0.02
4LR	93	0.03	0.06	0.10	217	0.07	0.15	0.26	217	0.07	0.15	0.26
4N	-	-	-	-	93	0.03	0.06	0.10	93	0.03	0.06	0.10
4V	-	-	-	-	31	0.01	0.02	0.03	31	0.01	0.02	0.03
NV	2,236	0.72	1.56	2.65	2,516	0.81	1.77	3.01	2,578	0.83	1.82	3.09
RCC	-	-	-	-	-	-	-	-	186	0.06	0.13	0.22
Total	**22,499**	**7.25**	**15.27**	**25.95**	**27,869**	**8.98**	**18.91**	**32.17**	**34,530**	**11.12**	**23.44**	**39.87**

SECTION 3
PLANNING AND ANALYSIS CRITERIA

This section presents the planning and analysis criteria used to analyze performance of the Grants Pass (City) water system. Criteria are presented for distribution system piping, service pressures, storage and pumping facilities. Recommended water needs for emergency fire suppression are also presented. These criteria are used in conjunction with the water demand forecasts developed in **Section 2** to complete analysis of the City's water distribution system presented in **Section 4**. Water supply capacity, evaluation criteria, and analysis are addressed in the 2014 *Water Treatment Plant Facility Plan Update* and 2015 *Emergency Operations Plan Update* (MSA).

The recommendations of this plan are based on the following performance guidelines, which have been developed through a review of State of Oregon requirements, American Water Works Association (AWWA) acceptable practice guidelines, Insurance Services Office, Inc. (ISO) guidelines and operational practices of similar water providers.

Distribution System Capacity and Service Pressures

Pressure Zone Configuration

Water distribution systems are separated by ground elevation into pressure zones in order to provide service pressures within an acceptable range to all customers. Typically, water from a reservoir will serve customers by gravity within a specified range of ground elevations so as to maintain acceptable minimum and maximum water pressures at each individual service connection. When it is not feasible or practical to have a separate reservoir for each pressure zone, pump stations or pressure reducing valves (PRVs) are used to serve customers in different pressure zones from a single reservoir.

It is recommended that all pressure zones incorporate at least one of the following strategies to promote service reliability and redundancy:

- Gravity storage within the pressure zone.
- Backup pump station power.
- Multiple pump stations supplying the pressure zone.
- A PRV connection to an upper pressure zone configured for emergency and supplemental fire flow supply. These valves should be equipped with pressure sustaining features to prevent under-pressurization of the upper pressure zone.

Normal Service Pressure

The desired service pressure range under average daily demand (ADD) and normal operating conditions is 35 to 80 pounds per square inch (psi). Whenever feasible, it is desirable to

achieve the 35 psi lower limit at the highest fixture within a structure. The maximum 80 psi service pressure limit is required by the *Oregon Plumbing Specialty Code* (OPSC) 608.2. Conformance to this pressure range may not always be possible or practical due to topographical relief and existing system configurations. Where mainline pressures exceed 80 psi, service connections should be equipped with individual PRVs.

The distribution system should be capable of supplying the peak hourly demand (PHD) while maintaining service pressures of not less than 85 percent of normal system pressures.

Service Pressure in an Emergency

During a fire flow event or emergency, the minimum service pressure is 20 psi as required by Oregon Health Authority, Drinking Water Services (OHA) and OAR 333-061-0025(7). The system should be capable of providing fire flow capacity while simultaneously delivering maximum day demands (MDD) and maintaining 20 psi throughout the distribution system. The system should meet this criterion with operational storage in the City's reservoirs depleted.

Distribution Piping Criteria

In general, distribution system piping flow velocities should not exceed 10 feet per second (fps) under fire flow conditions and 5 fps under normal demand conditions. Ductile iron is the City's standard water main pipe material with a minimum 8-inch diameter for new water mains.

Distribution System Water Quality

In Oregon, drinking water quality standards for 95 primary and 12 secondary contaminants are established under the Oregon Drinking Water Quality Act (OAR 333-061) which includes implementation of national drinking water quality standards. To maintain public health, each contaminant has either an established maximum contamninant level (MCL) or a recommended treatment technique. The 2014 *Grants Pass Water Treatment Plant Facility Plan Update* presented a comprehensive review of current and future water quality compliance issues relating to the City's source and treatment facilities. The following discussion focuses on three drinking water quality standards and potential contaminants that may be exasperated or originate in the distribution system. Specifically, microbial contaminants (Total Coliform Rule), lead and copper (Lead and Copper Rule) and disinfection by-products (Stage 2 Disinfectants and Disinfection Byproducts Rule).

Total Coliform Rule

There are a variety of bacteria, parasites, and viruses which can cause health problems when ingested. Testing water for each of these germs would be difficult and expensive. Instead, total coliform levels are measured. The presence of any coliforms in the drinking water suggests that there may be disease-causing agents in the water also. A positive coliform

sample may indicate that the water treatment system isn't working properly or that there is a problem in the distribution system. Although many types of coliform bacteria are harmless, some can cause gastroenteritis including diarrhea, cramps, nausea and vomiting. Gastroenteritis is not usually serious for a healthy person, but it can lead to more serious health problems for people with weakened immune systems.

Monitoring Requirements

The Total Coliform Rule applies to all public water systems. Total coliforms include both fecal coliforms and *E. coli*. Compliance with the MCL is based initially on the presence or absence of total coliforms in a sample, then a focus on the presence or absence of E.coli. For Grants Pass, the MCL is exceeded if more than five percent of the 40 required monthly samples have total coliforms present. A water system must collect a set of repeat samples for each positive total coliform result and have it analyzed for total coliforms and E.coli.

Lead and Copper and Corrosion Control

Lead and copper enter drinking water primarily through corrosion of plumbing materials most commonly caused by a chemical reaction with the water which may be due to dissolved oxygen, low pH or low mineral content. Exposure to lead and copper may cause health problems ranging from gastroenteritis to brain damage. In 1991, the national Lead and Copper Rule (LCR) established action levels for lead and copper concentrations in drinking water. Under the Oregon Drinking Water Quality Act, water utilities are required to implement optimal corrosion control treatment that minimizes the lead and copper concentrations at customers' taps, while ensuring that the treatment efforts do not cause the water system to violate other existing water regulations. It should be noted that an update to the LCR is currently being considered, though implications to the City's water system are anticipated to be minimal.

Monitoring Requirements

Utilities are required to conduct monitoring for lead and copper from taps in customers' homes. Samples are currently required to be taken every three years at 30 sampling sites. The action level for either compound is exceeded when, in a given monitoring period, more than 10 percent of the samples are greater than the action level.

Stage 2 Disinfectants and Disinfection Byproducts Rule (D/DBPR)

Disinfectants are used in public water systems to control microbial pathogens in source water which may cause gastrointestinal illness. These disinfectants can react with naturally-occurring material in the water to form by-products which have been found to increase health risks when consumed in larger concentrations over many years. The D/DBPR is focused on two groups of disinfection by-prodcuts, total trihalomethanes (TTHMs) and haloacetic acids (HAA5). Under Stage 2 of the D/DBPR, water providers are required to monitor running locational average concentrations of these by-products at sampling sites in the distribution

system previously identified under Stage 1 monitoring. These sampling sites represent the worst-case DBP water quality for the water system.

Monitoring Requirements

The City is currently conducting compliance monitoring under the Stage 2 D/DBPR which requires samples to be taken quarterly at each of four sampling sites. The locational running average at each site may not exceed the MCL for either TTHMs or HAA5s in order to remain in compliance.

Storage Volume

Water storage facilities are typically provided for three purposes: operational storage, fire storage, and emergency storage. A brief discussion of each storage element is provided below. Recommended storage volume is the sum of these three components. Adequate storage capacity must be provided for each pressure zone. Storage volume for pressure zones served through pressure reducing valves (PRVs) or by constant pressure pump stations is provided in the upstream pressure zone supplying the PRV or pump station.

Operational Storage

Operational storage is the volume of water needed to meet water system demands in excess of delivery capacity from the supply source to system reservoirs under PHD conditions. In the Grants Pass water system, Zone 1 is supplied from the Water Treatment Plant (WTP) while all other pressure zones are supplied through booster pump stations.

Pressure Zone 1

The WTP operates on a daily shift schedule rather than "call on-demand" based on reservoir water levels. Analysis of reservoir water levels recorded by the City in 2014 reveals that up to 4.6 million gallons per day (mgd) or 35 percent of system-wide MDD occurs when the plant is not in operation. Thus, Zone 1 storage facilities should have adequate operational storage to supply approximately 35 percent of MDD. In the future, as demand increases, plant operation is anticipated to change. Zone 1 operational storage capacity for the 20-year planning horizon and beyond will be evaluated based on a required capacity consistent with the method used for all other pressure zones as described in the following paragraphs.

All Other Pressure Zones

Operational storage capacity for all Grants Pass pressure zones above Zone 1 is evaluated based on the equalizing storage method from the Washington State Department of Health's *Water System Design Manual* (December 2009). For zones with gravity storage supplied by call on-demand pumping, this method defines minimum storage as the volume required to meet PHD for 2.5 hours with all non-emergency pumps serving the zone at full capacity.

Fire Storage

Fire storage should be provided to meet the single most severe fire flow demand within each zone. The fire storage volume is determined by multiplying the recommended fire flow rate by the expected duration of that flow consistent with the 2014 *Oregon Fire Code*. Specific fire flow and duration recommendations are discussed later in this section.

Emergency Storage

Emergency storage is provided to supply water from storage during emergencies such as pipeline failures, equipment failures, power outages or natural disasters. The amount of emergency storage provided can be highly variable depending upon an assessment of risk and the desired degree of system reliability. Provisions for emergency storage in other systems vary from none to a volume that would supply a maximum day demand or higher. Grants Pass has a single supply source from the Rogue River and the city's WTP which may become temporarily unavailable in the event of a major transmission main break or natural disaster. Due to this potential vulnerability the City's emergency storage criterion is 100 percent of MDD.

Pump Station Capacity

Pumping capacity requirements vary depending on how much storage is available, the number of pumping facilities serving a particular pressure zone, and the zone's maximum fire flow requirement. Pumping recommendations are based on firm capacity which is defined as a pump station's capacity with the largest pump out of service.

Pump station design guidelines, including a tool for determining preliminary pump station capacity needs and minimum pump station configuration and appurtenant component designs is included in **Appendix B**.

Pump Station supplying Pressure Zone with Gravity Storage

For pump stations supplying pressure zones with gravity storage available, the station must have adequate firm capacity to supply MDD for the zone.

Pump Station supplying Constant Pressure to Zone

Although it is desirable to serve water system customers by gravity from storage, constructing and maintaining a reservoir for a small group of customers may be prohibitively expensive and lead to water quality issues associated with slow reservoir turnover during low demand times. Constant pressure pump stations supply a pressure zone without the benefit of storage and are commonly used to serve customers at the highest elevations in a water service area where only an elevated reservoir would be capable of providing the necessary head to achieve adequate service pressures by gravity. Pump stations supplying constant pressure service should have firm pumping capacity to meet PHD while simultaneously supplying the largest fire flow demand in the zone.

Constant pressure pump stations are only recommended for areas with less than 200 Equivalent Residential Units (ERUs) and low water demand with limited potential for future looping with adjacent pressure zones. As presented in **Section 2**, an ERU is the volume of water used by a typical single-family residential service within the City's existing water service area. ERUs provide a common measure of water demand across all residential and non-residential water service types.

Standby Power

Standby power facilities are needed for constant pressure stations and for pump stations serving pressure zones with inadequate emergency storage capacity. Standby power is typically provided in the form of an on-site backup generator sized to operate the pump station at firm capacity with automatic transfer switches and on-site fuel storage.

Existing Grants Pass back-up generators or direct driven pumps are fueled with either diesel, propane or natural gas. Ideal fuel sources are evaluated on a case by case basis as pump stations are upgraded or new stations are constructed.

Fire Flow Recommendations

The amount of water recommended for fire suppression purposes is typically associated with the local building type or land use of a specific location within the distribution system. Fire flow recommendations are typically much greater in magnitude than the MDD in any local area. Adequate hydraulic capacity must be provided for these potentially large fire flow demands.

Fire protection within the current water service area is provided by the Grants Pass Public Safety Department / Fire Division. Fire flow requirements within the City are determined by the Fire Marshal consistent with the 2014 *Oregon Fire Code* (OFC). A summary of fire flow recommendations based on the OFC for each land use type within the city limits is presented in **Table 3-1**.

Table 3-1 also presents the average fire hydrant spacing recommended in the OFC. Per OFC requirements, the frontage of all residential properties are to be within 250 feet of a fire hydrant. City Water Standard 203.8.0 also requires that single family residential structures be within 500 feet of a fire hydrant.

Table 3-1
Summary of Recommended Fire Flows

Land Use Type (City zoning designations)	Recommended Fire Flow (gpm)	Duration (hours)	Recommended Average Fire Hydrant Spacing (feet)
Low and Moderate Density Residential: (R-1, R-2)	1,500	2	500
High Density and Multi-Family Residential: (R-3, R-4, R-5)	2,000	2	450
Commercial: (CBD, GC, NC, RTC)	3,000	3	400
Employment (Industrial): (BP,I, IP)	4,000	4	350
Institutional: (Schools, Hospitals)	4,000	4	350

Summary

The criteria developed in this section are used in **Section 4** to assess the system's ability to provide adequate water service under existing conditions and to guide improvements needed to provide service for future water needs. Planning criteria for the City's booster pump stations, distribution system, pressure zones, and storage facilities are summarized as follows:

- ***Service Pressure:***
    - Normal range under ADD conditions: 35 to 80 psi
    - Maximum per *Oregon Plumbing Specialty Code*: 80 psi
    - Minimum under PHD conditions: 85 percent of normal range
    - Minimum under emergency or fire flow conditions per OHA requirements: 20 psi
- ***Distribution Mains:***
    - Maximum velocity under normal operating conditions: 5 fps
    - Maximum velocity under emergency or fire flow conditions: 10 fps
- ***Storage Volume:*** Recommended storage volume capacity is the sum of the operational, fire and emergency storage volume components.
- ***Pump Station Capacity:*** Pump stations pumping to gravity storage facilities should have adequate firm capacity to provide MDD to the zone. Pump stations supplying constant pressure service without the benefit of storage should have firm pumping capacity to meet PHD while simultaneously supplying the largest fire flow demand in the pressure

zone. Constant pressure pump stations are not recommended for pressure zones larger than 200 ERUs.

- ***Fire Flow:*** The distribution system should be capable of supplying the recommended fire flows while maintaining minimum residual pressures everywhere in the system of 20 psi.

SECTION 4
WATER SYSTEM ANALYSIS

This section presents an analysis of the City of Grants Pass's (City's) water distribution system based on criteria outlined in **Section 3**. The water demand forecasts summarized in **Section 2** are used in conjunction with analysis criteria to assess water system characteristics including service pressures and zone boundaries, storage and pumping capacity and emergency fire flow availability. This section provides the basis for recommended distribution system improvements presented in **Section 5**.

Pressure Zone Analysis

Pressure zones are defined by ground topography. Their hydraulic grade lines (HGLs) are determined by overflow elevations of water storage facilities, discharge pressures of pump stations or outlet settings of pressure reducing facilities serving the zone. The City's existing distribution system is divided into five primary service levels (1, 2, 3, 4 and North Valley (NV)) defined by their HGLs. At each of these levels there are several hydraulically and geographically isolated pressure zones with similar HGLs. For the purposes of this analysis each hydraulically isolated pressure zone is considered independently regardless of service level or HGL. Existing and proposed future water service area boundaries and pressure zones are illustrated on the water system maps in **Appendix A**.

Existing Pressure Zones

The existing distribution system has both gravity storage and constant pressure zones. Zones currently served from finished water storage reservoirs include Zones 1, 2, 3, 4 and NV. Constant pressure zones are those which supply customers from booster pump stations without the benefit of storage. Constant pressure zones currently serve areas at higher elevations to the north and southeast of the city center including Zones 2HT (Hilltop), 2HK (Harbeck), 2MW (Meadow Wood low), 2NH (New Hope), 3MW (Meadow Wood high), 3P (Panoramic), 3S (Starlite) and 4LR (Laurel Ridge). Constant pressure zones are only recommended for areas with 200 Equivalent Residential Units (ERUs) or less, low water demand and limited potential for expansion or future looping. The existing system also includes two pressure reducing valve (PRV)-controlled subzones, 2A in the central city and 3B along Beacon Drive between Zones 2 and 4. Existing pressure zones are summarized in **Section 1**, **Table 1-2**.

The City's existing pressure zones provide adequate service pressures between 35 and 80 pounds per square inch (psi) to the majority of current water system customers. Some customers at slightly higher elevations on the perimeter of the distribution system, those near pressure zone boundaries or those in areas with limited existing water system piping may have pressures below 35 psi.

Proposed Future Pressure Zones

As the City's water service area grows into the urban growth boundary (UGB), the water system will need to provide adequate service pressure to more high-elevation customers at the perimeter of the existing distribution system. Where possible, the future service area growth will be supplied by extending piping from existing pressure zones. As existing constant pressure zones expand to include more than 200 ERUs, new storage reservoirs are recommended to supply customers by gravity. Proposed future pressure zone conversions from constant pressure to gravity service as well as new constant pressure zones are summarized in **Table 4-1**.

Future constant pressure zones are also proposed to serve isolated high elevation areas within the UGB and urban reserves as the water service area expands and development warrants. Some of the proposed constant pressure zones, such as 2SW (Southwest), 4GH (Granite Hill) and 4V (Vertical Dr), serve isolated high-elevation areas of less than five acres. In these cases, booster pumps on individual services may be a more feasible option to serve small groups of customers rather than creating new constant pressure zones including pumping facilities with adequate capacity to supply required fire flows.

Future Pressure Zone Boundary Changes

In order to adequately serve the UGB, significant expansion or changes are recommended for some of the City's existing pressure zone boundaries. Each of the following zone boundary adjustments is discussed in more detail in **Appendix C** including any alternative configurations which were considered:

Proposed Zone 2H

Proposed Zone 2H combines existing water mains in Zones 2HK (Harbeck) and 2HT (Hilltop) into a single zone. Zone 2H will be expanded through transfer of Zone 1 mains on Grandview Avenue to complete a Zone 2H loop for improved service pressures and fire flow availability in the area. This zone change would also allow the undersized Harbeck Pump Station to be abandoned. Implementing Zone 2H is dependent on construction of new mains through developable land where there is no existing public rights-of-way, thus this zone boundary change is anticipated to proceed only as develop warrants.

Spalding Industrial Area Zone 2 Expansion

New Zone 2 facilities are needed to provide adequate service pressure to future development in the Spalding Industrial area southeast of the intersection of the Redwood Highway (Hwy 199) and Interstate 5 (I-5). A new Zone 2 reservoir is proposed near Pearce Park to provide service pressure and fire storage. Existing Zone 1 mains on Foothill Boulevard north of Hwy 199, which receive minimal existing service pressure, would also be converted to the higher-HGL Zone 2. The converted Foothill Boulevard mains would loop the Spalding Industrial area with existing Zone 2 facilities north of NE A Street. The future Spalding Industrial area

cannot be adequately served from the existing Foothill Boulevard mains under either Zone 1 or Zone 2 service pressure, additional storage is required. This proposed zone expansion is anticipated to proceed as development in the Spalding Industrial area warrants.

Zone 3 and 4 service north of I-5

Recent expansion of the City's UGB included a large area north of I-5 between Granite Hill Road and existing Zone 4 customers in the Hillcrest neighborhood. Elevations in this area fall in the service range for existing Zones 3 and 4. Proposed Zone 3 properties in this area have an employment zoning designation which requires a large, 4,000 gallon per minute (gpm) fire flow. As presented in **Appendix C**, three alternatives, Options A, B and C were evaluated for future service to this area. Proposed facilities presented in the **Section 5** Capital Improvement Program (CIP) table reflect Option C. These facilities include:

- construction of an additional water main crossings under I-5 at NE Greenfield Drive and NW Scenic Drive
- new large diameter Zone 3 and 4 looped mains
- new Zone 4 pump station and storage facility on the City's Ausland Drive site to replace undersized existing Reservoir No. 13
- conversion of low elevation Zone 4 Hillcrest customers to Zone 3
- abandoning existing Hefley Pump Station and Beacon Drive PRV

Proposed Zone 4N

Recent expansion of the City's UGB included employment-zoned properties north of the current city limits along I-5 and Highland Avenue which are too high in elevation to be served from the existing North Valley Reservoir. A new constant pressure pump station and 16-inch diameter distribution main are needed to provide adequate service pressure and fire flow to potential customers in this area. This proposed zone expansion is anticipated to proceed as development warrants.

Table 4-1
Future Pressure Zone Summary

Zone ID	Description	Existing Zone Type	Future Zone Type	Zone Supplied From
1		Gravity storage	Gravity storage	-
1RR	River Road	-	PRV subzone	1
2		Gravity storage	Gravity storage	-
2A		PRV subzone	PRV subzone	2
2FD	Fruitdale	-	Constant pressure[1]	1
2H	Hilltop & Harbeck	Constant pressure	Constant pressure	1
2MW	Meadow Wood (low)	Constant pressure	Gravity storage	Existing = 1
2NH	New Hope	Constant pressure	Gravity storage	Existing = 1
2SW	Southwest	-	Constant pressure	1
3		Gravity storage	Gravity storage	-
3BG	Blue Gulch	-	PRV subzone	4LR
3MW	Meadow Wood (high)	Constant pressure	Constant pressure	1
3P	Panoramic	Constant pressure	Constant pressure	2MW
3S	Starlite	Constant pressure	PRV subzone[2]	Existing = 1 Future = 4LR
3SE	Southeast	-	Constant pressure	2MW
3WX	Williams Crossing	Constant pressure	Constant pressure	2NH
4		Gravity storage	Gravity storage	-
4GH	Granite Hill	-	Constant pressure	3
4LR	Laurel Ridge	Constant pressure	Gravity storage	Existing = 3
4N	North	-	Constant pressure	NV
4V	Vertical Drive	-	Constant pressure	4
NV	North Valley	Gravity storage	Gravity storage	-
RCC	Rogue Community College	-	See following discussion	-

Notes:
1. Zone 2FD would be initially served as a constant pressure zone. As development warrants, 2FD distribution piping will be merged with the future 2MW gravity storage zone and any 2FD pump station would be abandoned.
2. With the development of 4LR gravity storage, 3S may be converted to a PRV subzone and the Starlite Pump Station abandoned.

Rogue Community College (RCC)

As described in **Sections 1** and **2**, RCC is currently supplied through a private water distribution system with a dedicated groundwater source. For the purposes of this analysis, it is assumed that RCC may receive water service from the City within the 30-year planning horizon. However, there is currently no indication that RCC will pursue City water service in the foreseeable future.

The RCC campus property falls between approximately 1,005 and 1,130 feet elevation, straddling the service elevations for existing adjacent pressure Zone 1 and Zone 2. All current development on the RCC campus is below approximately 1,050 feet elevation. Estimated demands presented in **Section 2** included only the existing 30 acres of developed campus property. Previous planning efforts identified the RCC campus as Zone 2B. Based on discussions with City staff, previous planning work informally proposed two primary approaches to providing future water service to RCC:

1. Storage reservoirs which would supply the campus by gravity at approximately the same HGL as the existing on-campus reservoir which is part of the RCC private water system. This solution also requires a booster pump station to fill the proposed reservoir from existing nearby Zone 1 distribution piping.

2. A booster pump station near the college which could supply a future Zone 1 storage reservoir nearby as well as provide constant pressure service to the RCC campus, some of which is above the maximum Zone 1 service elevation of approximately 1,020 feet.

Option 1 – RCC Storage Reservoir

Existing development at the RCC campus which is below approximately 1,050 feet elevation, could be effectively served at an HGL of approximately 1,140 feet. RCC's existing private water system reservoirs are at a ground elevation of approximately 1,125 feet with an assumed overflow elevation of approximately 1,155 feet. Based on estimated demands for the existing 30 acre campus and assuming an institutional fire flow requirement of 4,000 gallons per minute (gpm), a potential reservoir should have an approximate capacity of 1.2 million gallons (MG). The City's *2001 Water Distribution System Master Plan* (*2001 WDSMP)* refers to the proposed RCC reservoir as Reservoir No. 12.

A new City booster pump station would also be required to fill a proposed RCC Reservoir from adjacent Zone 1 distribution piping. Based on estimated maximum day demand (MDD) for the existing 30 acre campus, a potential pump station supplying the proposed reservoir should have an approximate capacity of 90 gpm.

Future service to potential development at higher elevations on the RCC campus property would likely be served as a separate constant pressure zone supplied by a proposed booster pump station adjacent to a potential RCC storage reservoir. This potential RCC expansion is not evaluated as part of this WDSMP.

Option 2 – Constant Pressure Service

The RCC campus could be supplied as a constant pressure zone from a future RCC pump station at the intersection of Hubbard Lane and Canal Avenue. This approach may be advantageous if the City needs to construct additional Zone 1 storage facilities near the college. Based on previous planning work, a future Zone 1 storage reservoir this far from the City's Water Treatment Plant (WTP) would be expected to need additional booster pumping to overcome losses in the distribution piping and fill the reservoir. In this case a future RCC pump station would serve a dual purpose, filling the Zone 1 storage reservoir and providing constant pressure service to the college. Constant pressure service does present some challenges such as the college's 4,000 gpm required fire flow which the future pump station would need to provide with redundant pumps. A proposed RCC constant pressure station should be capable of providing peak hour demand (PHD) plus fire flow to the existing campus with an approximate firm capacity of 4,200 gpm.

At this time, improvements to provide water service to RCC are not recommended in this WDSMP. The need to plan for future service to RCC, and the most effective approach to provide service should be re-evaluated in future updates of this WDSMP.

Storage Analysis

Condition Assessment

Reservoir site visits were conducted to identify any major exterior issues and included a cursory inspection of on-site control buildings and valve vaults. No issues were identified at any of the reservoir sites. Recent inspection of the structural condition of Reservoir Nos. 4, 6 and 11 identified concerns regarding the condition of these facilities. It is recommended that the City complete a full structural evaluation of all three reservoirs in the next two years to determine the extent of repairs required to maintain these reservoirs in reliable service. The evaluation should include an analysis of each reservoir's expected performance in a seismic event.

Capacity

Storage facilities are provided for three purposes: operational storage, emergency or standby storage and fire suppression storage. As presented in **Section 3**, the total storage required is the sum of these three elements.

Storage reservoirs must have adequate capacity to meet demands within the zone being supplied by gravity as well as demands in all PRV subzones and all constant pressure zones pumping out of the gravity zone. For example, Zone 2 Reservoir Nos. 4 and 6 must have adequate capacity to meet demands in Zone 2 as well as PRV subzone 2A and Zone 3S which is supplied from Zone 2 through the Starlite Pump Station.

Fire storage is determined by the maximum fire flow requirement of the gravity zone and any PRV subzones. Constant pressure zones cannot be adequately supplied fire flow from a lower-elevation reservoir and must have adequate pumping capacity to meet fire flow requirements.

Existing Storage

Pressure zones 1, 2, 3, 4 and NV are currently supplied by gravity from finished water storage reservoirs. Under existing demand conditions, Zones 1 and 2 have adequate capacity to meet storage criteria. There are storage deficits in both Zone 3 and Zone 4. Existing storage requirements and current capacity in MG are summarized in **Table 4-2**.

Table 4-2
Existing Storage Analysis

Pressure Zone	Other Zones Served	Existing Reservoirs Supplying Zone	Required Storage Volume (MG)				Existing Storage (MG)	Storage Volume Deficit (MG)
			Operational	Standby	Fire Suppression	TOTAL		
1	2HK, 2HT, 2MW, 2NH, 3MW, 3P, 3WX	3, 5, 11	2.84	8.12	0.96	11.92	13.0	**0.0**
2	2A, 3S	4, 6	0.00	1.78	0.96	2.74	4.25	**0.0**
3	4LR	8	0.00	1.17	0.96	2.13	2.0	**0.2**
4	3B	13	0.00	0.12	0.18	0.30	0.08	**0.3**
NV	-	15	0.00	0.05	0.96	1.01	1.3	**0.0**

North Valley

The North Valley Reservoir No. 15 has significant surplus capacity under existing conditions. The reservoir is currently operated approximately one-quarter full due to slower than anticipated growth in North Valley and water quality concerns associated with slow reservoir turnover. At this lower operating level, the reservoir storage volume is approximately 0.3 MG. Reservoir No. 15 should be providing approximately 0.96 MG of fire storage in order to supply a 4,000 gpm industrial fire flow. It is recommended that the City operate the North Valley Reservoir No. 15 at least three-quarters full to provide adequate fire storage.

This operational change may not be practical due to water quality concerns associated with slow reservoir turnover. In that case the City may wish to assess the following recommended alternatives:

1. Increase pumping and transmission capacity from the North Valley Pump Station to Reservoir No. 15 such that the reservoir may be quickly refilled as storage is depleted in a fire emergency. It should be noted that larger North Valley transmission mains would be costly to construct and would likely have similar water quality concerns due to low demand under normal operating conditions

2. Work with the Grants Pass Public Safety / Fire Division and Rural/Metro Fire to determine current fire flow requirements for existing development in the North Valley Zone and operate Reservoir No. 15 at a level sufficient to provide fire storage for these existing customers. Actual fire flow requirements for existing structures may be lower than the 4,000 gpm industrial fire flow criteria due to automatic fire sprinkler systems and specific building construction materials, size and occupancy use.

Proposed Future Storage

As the City's water service area grows, water demand projections indicate that some existing constant pressure pumped zones will expand to include more than 200 ERUs. Storage reservoirs are recommended to supply customers by gravity in zones with more than 200 ERUs as described in **Section 3**. The future storage analysis presented in **Table 4-3** includes existing gravity zones as well as those existing constant pressure pumped zones which are anticipated to grow beyond 200 ERUs and are recommended for conversion to gravity zones. Proposed reservoirs are recommended to serve new gravity zones in the Meadow Wood, New Hope / Cathedral Hills and Laurel Ridge areas.

Table 4-3
Proposed Future Storage Analysis

Pressure Zone	Other Zones Served	Timeframe	Total ERUs	Required Storage Volume (MG)				Existing Effective Storage (MG)	Storage Volume Deficit (MG)
				Operational	Standby	Fire Suppression	TOTAL		
1	1RR, 2HK, 2HT, 2SW	**10-Year**	14,142	3.34	9.55	0.96	13.85	13.0	**0.9**
		20-Year	17,011	0.00[1]	11.49		12.45		**-**
		30-Year	22,272	0.00	15.05		16.01		**3.1**
2	2A, 3S (10-Year only)	**10-Year**	3,230	0.00	2.19	0.96	3.15	4.25	**-**
		20-Year	3,198	0.00	2.16		3.12		**-**
		30-Year	3,261	0.00	2.20		3.16		**-**
2MW	2FD, 3MW, 3P, 3SE	**10-Year**	282	0.00	0.19	0.18	0.37	0.0	**0.4**
		20-Year	971	0.00	0.65		0.83		**0.9**
		30-Year	1,531	0.00	1.04		1.22		**1.3**
2NH	3WX	**10-Year**	292	0.00	0.20	0.54	0.74	0.0	**0.8**
		20-Year	726	0.00	0.49		1.03		**1.1**
		30-Year	913	0.00	0.62		1.16		**1.2**
3	4GH, 4LR (10-Year only)	**10-Year**	2,112	0.00	1.43	0.96	2.39	2.0	**0.4**
		20-Year	2,341	0.00	1.59		2.55		**0.6**
		30-Year	2,590	0.00	1.75		2.71		**0.8**
4	3B, 4V	**10-Year**	217	0.00	0.15	0.18	0.33	0.08	**0.4**
		20-Year	435	0.00	0.29		0.47		**0.5**
		30-Year	528	0.00	0.36		0.54		**0.6**
4LR	3BG, 3S	**10-Year**	-	-	-	0.18	-	0.0	**-**
		20-Year	465	0.00	0.32		0.50		**0.5**
		30-Year	465	0.00	0.32		0.50		**0.5**
NV	4N	**10-Year**	2,236	0.12	1.56	0.96	2.64	1.3	**1.4**
		20-Year	2,609	0.16	1.83		2.95		**1.7**
		30-Year	2,671	0.17	3.01		3.01		**1.8**

Notes: 1. As described in Section 3, Zone 1 operational storage requirements are reduced beyond the initial 10-year planning horizon to reflect future WTP operations.

Zone 1

Zone 1 Reservoir Nos. 3, 5 and 11 have an approximate 0.9 MG storage deficit within the 10-year planning window. This 10-year Zone 1 storage deficit is due to large operational storage capacity requirements. As discussed in **Section 3**, the City's WTP is currently operated on a daily shift schedule rather than "call on-demand" based on reservoir water levels. Thus Zone 1 operational storage volume is calculated using conservative criteria through the 10-year planning window to account for demands which may occur while the WTP is not operating.

In the 20-year planning window, it is assumed that increased system-wide demands will require the City to begin operating the WTP on a 24-hour call on-demand basis or clearwell capacity will be provided for high service pump station operation while the WTP is idle. Zone 1 operational storage requirements at 20 years are calculated using the same criteria as all other City pressure zones which significantly reduces required storage capacity in Zone 1. As presented in **Table 4-3**, there is no storage deficit in Zone 1 reservoirs at the 20-year planning horizon. It is recommended that short-term Zone 1 storage requirements be re-evaluated as planning for future WTP replacement progresses.

In the long-term, it is recommended that the City plan for an additional Zone 1 storage reservoir with an approximate capacity of 3.1 MG. This facility would be needed to serve existing City residents who are currently supplied from private wells when and if they become City water customers as well as new development in the UGB and urban reserve areas. It is recommended that this long-term Zone 1 storage need be further evaluated as WTP capacity is expanded and continued in-fill development and growth occurs. The 20-year CIP prescribed in this WDSMP does not include construction of new Zone 1 storage.

Zone 2

Zone 2 Reservoir Nos. 4 and 6 have adequate storage through the 20-year and saturation development planning horizons. In order to provide adequate service pressure to the Spalding Industrial area and proposed Zone 2 service area expansion along Foothill Boulevard, new Zone 2 storage will be required as it is not practical to construct large diameter transmission mains from Reservoir No. 4 and south on Foothill Boulevard to the future industrial development. Proposed Reservoir No. 19 should have an approximate capacity of 1.2 MG to provide emergency storage and adequate volume to meet a 4,000 gpm industrial fire flow requirement.

Zone 3

Zone 3 Reservoir No. 8 has an approximately 0.2 MG storage deficit under existing conditions. This deficit is projected to increase with anticipated growth to approximately 0.8 MG at saturation development. It is recommended that the City plan for a second Zone 3 storage reservoir in the long term.

Zone 4

Zone 4 Reservoir No. 13 has an approximately 0.3 MG storage deficit under existing conditions. This deficit is projected to increase with anticipated growth to approximately 0.5 MG at saturation development. Due to the large existing capacity deficit, including inadequate fire suppression storage, and site accessibility limitations at the reservoir, it is recommended that the City plan to replace the existing 0.08 MG Reservoir No. 13 with a new approximately 0.6 MG reservoir within the next 5 years.

North Valley

The North Valley Reservoir No. 15 has excess capacity under existing demand conditions. As presented in **Table 4-3**, within the 10-year planning window a significant deficit of 1.4 MG develops based on projected future demands, growing to 1.8 MG at saturation development. These future demand projections, discussed in detail in **Section 2**, are heavily influenced by future development in Paradise Ranch. In 2005, the City established agreements with the Paradise Ranch Resort developer to supply domestic water demands, limited interruptible golf course irrigation and water for fire protection. Although it is recommended that the City continue long-range planning which considers these agreements with Paradise Ranch, future development timing in the proposed resort area is still largely unknown. It is recommended that necessary storage capacity to serve North Valley be re-evaluated as development occurs, and that the CIP presented in this WDSMP does not include the construction of additional North Valley storage in the 20-year planning horizon.

Meadow Wood

The Meadow Wood area in southeast Grants Pass is currently supplied constant pressure from the Meadow Wood Pump Station to Zones 2MW and 3MW. Based on future growth projections, a new reservoir is proposed within the 10-year planning horizon to replace constant pressure service to Zone 2MW with gravity service. The proposed Meadow Wood Reservoir No. 16 would provide suction supply to the Panoramic Pump Station (Zone 3P) and Zone 3MW pumps at the existing Meadow Wood Pump Station.

As development occurs, the proposed Reservoir No. 16 would also serve customers in the proposed Zone 2FD and provide suction supply to a proposed constant pressure pump station serving proposed Zone 3SE. Proposed Reservoir No. 16 should have an approximate capacity of 1.3 MG to meet projected saturation development demands as presented in **Table 4-3**.

New Hope / Cathedral Hills

The New Hope / Cathedral Hills area along the Williams Highway in south Grants Pass is currently served by constant pressure pumping from the New Hope Pump Station. This area is designated as Zone 2NH. Based on future growth projections, a new reservoir is proposed within the 10-year planning horizon to replace constant pressure service with gravity service. In addition to serving existing customers and anticipated growth in Zone 2NH, this proposed

Reservoir No. 17 would provide suction supply to the small Williams Crossing Pump Station (Zone 3WX). Proposed Reservoir No. 17 should have an approximate capacity of 1.2 MG to meet projected saturation development demands as presented in **Table 4-3**.

Laurel Ridge

The Laurel Ridge area along NW Starlite Place in northwest Grants Pass is currently supplied constant pressure from the Laurel Ridge Pump Station to Zone 4LR. Based on future growth projections, a new reservoir is proposed within the 20-year planning horizon to replace constant pressure service with gravity service. In addition to serving customers in Zone 4LR, the proposed Reservoir No. 14 would ultimately supply future development in the Blue Gulch area south of Laurel Ridge (future Zone 3BG) and existing customers in Zone 3S.

Zone 3BG is proposed as a PRV-controlled sub-zone served from proposed Laurel Ridge Reservoir No. 14. Zone 3S is currently supplied constant pressure from the Starlite Pump Station and through the existing Starlite PRV. Following construction of proposed Reservoir No. 14, it is recommended that the Starlite Pump Station be abandoned and Zone 3S be served through the Starlite PRV. Proposed Reservoir No. 14 should have an approximate capacity of 0.5 MG to meet projected saturation development demands as presented in **Table 4-3**.

Pumping Capacity Analysis

Pumping capacity requirements are estimated based on available storage, the number and size of pumps serving the zone and the zone's maximum fire flow requirement. Recommendations are based on firm capacity which is defined as a pump station's capacity with the largest pump out of service.

In pressure zones supplied by gravity, operational and fire storage provided by reservoirs make it unnecessary to plan for fire flow or peak hour capacity from pump stations assuming adequate storage is available. Pump stations supplying gravity zones must have sufficient firm capacity to meet the maximum day demand for all customers in the zone and any higher level zones supplied from the primary zone.

Constant pressure pump stations supply a pressure zone without the benefit of storage. These stations are only recommended for areas with 200 ERUs or less and low water demand with limited potential for future looping with adjacent pressure zones. Pump stations supplying constant pressure service must have firm pumping capacity to meet peak hour demands while simultaneously supplying the largest fire flow demand in the zone**.** The pumping capacity analysis is summarized in **Table 4-4**.

Table 4-4
Pumping Capacity Analysis

Zone	Existing Pump Stations	Existing Firm Capacity (gpm)	Current				10-Year				20-Year				30-Year (Saturation)			
			Other Zones Served	Required Capacity		Needed	Other Zones Served	Required Capacity		Needed	Other Zones Served	Required Capacity		Needed	Other Zones Served	Required Capacity		Needed
				Type	gpm	gpm		Type	gpm	gpm		Type	gpm	gpm		Type	gpm	gpm
1	WTP High Service Pumps	16,600	2, 2HK, 2HT, 2MW, 2NH, 3MW	MDD	6,535	-	2, 2HK, 2HT, 2MW, 2NH	MDD	7,993	-	2, 2HK, 2HT, 2MW, 2NH, 2SW	MDD	9,826	-	1RR, 2, 2HK, 2HT, 2MW, 2NH, 2SW	MDD	12,583	-
2	Lawnridge, Madrone	3,790	2A, 3, 3S	MDD	2,014	-	2A, 3, 3S	MDD	2,472	-	2A, 3	MDD	2,597	-	2A, 3	MDD	2,736	-
2FD	-	0										PHD + FF	1,549	1,549		Served by gravity from 2MW		
2HK	Harbeck	168		PHD + FF	1,524	1,356		PHD + FF	1,524	1,356		PHD + FF	1,524	1,356		PHD + FF	1,549	1,381
2HT	Hilltop	1,676		PHD + FF	1,524	-		PHD + FF	1,524	-		PHD + FF	1,549	-		PHD + FF	1,549	-
2MW	Meadow Wood (low)	150	3P	PHD + FF	1,667	1517	3MW, 3P	MDD	119	-	2FD, 3MW, 3P, 3SE	MDD	556	406	2FD, 3MW, 3P, 3SE	MDD	722	572
2NH	New Hope	700	3WX	PHD + FF	3,177	2477	3WX	MDD	132	-	3WX	MDD	336	-	3WX	MDD	528	-
2SW	-	0										PHD + FF	1,514	1,514		PHD + FF	1,514	1,514
3	Champion	2,400	4LR, NV	MDD	778	-	4LR, NV	MDD	951	-	4GH, 4LR, NV	MDD	1,306	-	4GH, 4LR, NV	MDD	1,465	-
3MW	Meadow Wood (high)	500		PHD + FF	1,501	1,001		PHD + FF	1,502	1,002		PHD + FF	1,606	1,106		PHD + FF	1,606	1,106
3P	Panoramic	1,220		PHD + FF	1,512	292		PHD + FF	1,521	301		PHD + FF	1,521	301		PHD + FF	1,521	301
3S	Starlite	618		PHD + FF	1,512	894		PHD + FF	1,521	903								
3SE	-	0										PHD + FF	1,505	1,505		PHD + FF	1,681	1,681
3WX	Williams Crossing	70		PHD	8	-		PHD	14	-		PHD	14	-		PHD	14	-
4	Hefley	958		MDD	83	-		MDD	104	-		MDD	187	-		MDD	236	-
4GH	-	0										PHD + FF	4,014	4,014		PHD + FF	4,014	4,014
4LR	Laurel Ridge	700		PHD + FF	1,559	859		PHD + FF	1,569	869	3BG, 3S	MDD	222	-	3BG, 3S	MDD	222	-
4N	-	0										PHD + FF	4,069	4,069		PHD + FF	4,069	4,069
4V	-	0										PHD + FF	1,521	1,521		PHD + FF	1,521	1,521
NV	North Valley	570		MDD	35	-		MDD	1083	513	4N	MDD	1271	701	4N	MDD	1306	736

Notes:
1. 2HK pumping capacity deficit is planned to be addressed through the future integration of Zones 2HK and 2HT. Hilltop Pump Station capacity is adequate to supply the combined Zone 2H.

Existing Pump Stations

Existing pump stations serving gravity Zones 1, 2, 3 and 4 have adequate firm pumping capacity to supply MDD to zone reservoirs under existing and projected future demand conditions through saturation development.

North Valley Pump Station (Zone NV)

As with the storage capacity analysis, the existing Zone NV North Valley Pump Station has adequate pumping capacity under existing conditions but develops a significant pumping deficit within the 10-year planning horizon based on projected demand growth in the North Valley area. This projected demand growth is heavily influenced by future development in Paradise Ranch. Although it is recommended that the City continue long-range planning which considers 2005 agreements with the Paradise Ranch developer to provide water service, future development timing in the proposed resort area is still largely unknown. Thus, it is recommended that necessary pumping capacity to supply the North Valley Reservoir No. 15 and Zone NV customers be re-evaluated as development occurs.

Existing Constant Pressure Pump Stations

The Williams Crossing Pump Station has adequate capacity to meet projected demands for Zone 3WX through saturation development. It is assumed that fire flow is provided to the six customers in Zone 3WX from the adjacent Zone 2NH distribution system.

Existing constant pressure pump stations Meadow Wood low level (Zone 2 MW), New Hope and Laurel Ridge are proposed for conversion to gravity zones, with pumps supplying a storage reservoir, within the 20-year planning horizon. Each of these stations and pressure zones are discussed in more detail under the ***Proposed Future Pump Stations*** below.

Meadow Wood high level (Zone 3MW), Panoramic and Starlite Pump Stations all have capacity deficits under existing conditions. It is recommended that the Meadow Wood high level pumps and Panoramic Pump Stations be upgraded to provide adequate fire flow at firm capacity. As discussed under the ***Proposed Future Pump Stations*** heading below, the Starlite Pump Station is anticipated to be abandoned following construction of the proposed Laurel Ridge Reservoir No. 14. In the interim, supplemental fire flow is provided to the Starlite Zone from the Laurel Ridge PRV.

<u>Hilltop and Harbeck (Zones 2HT and 2HK)</u>

The existing constant pressure Hilltop Pump Station has adequate firm capacity to meet projected Zone 2HT peak hour demands and provide adequate residential fire flow capacity through saturation development. Neighboring Zone 2HK, supplied constant pressure from the existing Harbeck Pump Station, has insufficient firm capacity to supply residential fire flow. As development occurs, distribution piping may be extended to connect Zones 2HT and 2HK to form a single proposed Zone 2H. With these two zones hydraulically connected

through adequately sized distribution piping, the Hilltop Pump Station could supply adequate firm capacity and the undersized Harbeck Pump Station could be abandoned. Further discussion of proposed Zone 2H is presented in Appendix C. It is recommended that capacity upgrades to the Harbeck Pump Station to meet residential fire flow requirements be re-evaluated as development occurs. For the purpose of the CIP presented in this WDSMP, it is assumed that the piping necessary to connect the two pressure zones will be constructed and that Harbeck Pump Station can be abandoned.

Proposed Future Pump Stations

Meadow Wood low level (Zone 2MW)

The Meadow Wood area is currently served by constant pressure pumping. Under existing conditions, the Meadow Wood Pump Station low level pumps (Zone 2MW) require additional firm capacity to provide current PHD and fire flow to Zone 2MW and PHD to Panoramic Loop (Zone 3P) customers. Within 10 years, Zone 2MW is anticipated to grow beyond the 200 ERU maximum recommended for constant pressure zones. As described earlier in this section, a proposed storage reservoir is recommended for construction within the 10-year planning horizon to replace constant pressure service with gravity service. When Zone 2MW is transitioned to gravity service, fire flow and operational (peak hour) capacity will be provided from proposed Reservoir No. 16 and will no longer be required from the Meadow Wood Pump Station low level pumps.

Under projected future demand conditions the Meadow Wood Pump Station low level pumps have adequate firm capacity to supply MDD through the 10-year planning window. It is recommended that the pump station's low level capacity be expanded within the 20-year planning horizon to meet projected MDD at saturation development in existing Zones 2MW, 3MW and 3P as well as proposed future Zones 2FD and 3SE. This additional capacity may be provided instead from a proposed Fruitdale Pump Station which would initially supply proposed Zone 2FD by constant pressure as development warrants. For the purpose of the CIP presented in this WDSMP, expansion of the Meadow Wood low level pumping capacity is not included and should be re-evaluated based on the timing and configuration of development in Zones 2FD and 3SE.

New Hope / Cathedral Hills (Zone 2NH)

The New Hope area is currently served by constant pressure pumping. Under existing conditions, the New Hope Pump Station requires additional firm capacity to provide current PHD and fire flow to New Hope and Williams Crossing customers. Within 10 years, the New Hope area is anticipated to grow beyond the 200 ERU maximum recommended for constant pressure zones based on demand projections presented in **Section 2**. As described earlier in this section, a proposed storage reservoir is recommended for construction within the 10-year planning horizon to replace constant pressure service with gravity service. When Zone 2NH is transitioned to gravity service, fire flow and operational (peak hour) capacity will be provided from proposed Reservoir No. 17 and will no longer be required from the

New Hope Pump Station. Under projected future demand conditions the New Hope Pump Station has adequate firm capacity to supply MDD through saturation development. If it is determined that the timing of Reservoir No. 17 construction is delayed beyond the 10-year planning horizon, a redundant high capacity pump should be added to the pump station in order to provide adequate firm pumping capacity.

Ausland Pump Station (Zone 4)

Zone 4 is currently served by the Hefley Pump Station and Reservoir No. 13. As described under the ***Proposed Future Pressure Zones*** and the **Storage Analysis** headings, in order to address the storage deficiency in Zone 4 and provide for expansion of Zone 4 inside the UGB north of I-5, new Zone 4 storage and pumping is recommended within the next 5 years. The new Ausland Pump Station would allow for the abandonment of the Hefley Pump Station.

Laurel Ridge (Zone 4LR)

Laurel Ridge is currently served by constant pressure pumping. Under existing and projected 10-year demand conditions, the Laurel Ridge Pump Station requires additional firm capacity to provide PHD and fire flow to Laurel Ridge customers. In the short term it is recommended that the Laurel Ridge Pump Station be expanded to include a redundant high capacity pump capable of supplying 1,500 gpm in the event of a fire emergency.

Within 20 years, the Laurel Ridge area is anticipated to grow beyond the 200 ERU maximum recommended for constant pressure zones based on demand projections. As described earlier in this section, a proposed storage reservoir is recommended for construction within the 20-year planning horizon to replace constant pressure service with gravity service. When Zone 4LR is transitioned to gravity service, fire flow and operational (peak hour) capacity will be provided from proposed Reservoir No. 14 and will no longer be required from the Laurel Ridge Pump Station. Under projected 20-year and saturation development demand conditions the Laurel Ridge Pump Station has adequate firm capacity.

Proposed Future Constant Pressure Pump Stations

New constant pressure pump stations are proposed to provide PHD and fire flow to small, high elevation areas within the City's UGB and urban reserves as development warrants. Based on service area boundaries and projected demands developed in **Section 2**, Zones 2FD, 2SW, 3SE, 4GH, 4N and 4V have the potential for development within the 20-year planning horizon. The recommended firm capacity of these proposed pump stations is largely determined by the required fire flow for the proposed pressure zone. Due to proposed employment and institutional zoning in pressure Zones 4N and 4GH, these stations should be capable of providing over 4,000 gpm at firm capacity. For the purpose of the CIP presented in this WDSMP, these future pump stations, which will be driven by development, are assumed to be 100% developer funded and are not included in the CIP.

Back-Up Power

At least two independent power sources are recommended for the City's pump stations. It is recommended that pump stations supplying gravity storage reservoirs include, at a minimum, manual transfer switches and connections for a portable back-up generator. The emergency storage volume in each reservoir will provide short term water service reliability in case of a power outage at the pump station. Back-up power is particularly critical for stations providing constant pressure service. On-site standby power generators with automatic transfer switches are recommended for all constant pressure pump stations serving zones without the benefit of gravity storage.

On-site back-up power generators are installed at the existing WTP high level pumps and all constant pressure pumping stations, except Williams Crossing and Starlite. Both of the zones served by these stations will continue to be supplied with water in the event of a loss of power.

The City is in the process of installing a manual transfer switch and generator plug at Lawnridge, Madrone, Champion, Hefley and North Valley pump stations. The City has acquired a trailer mounted diesel generator to allow operation of at least one pump at each of these stations.

Pump Station Condition Assessment

In December 2015, MSA conducted site visits with City staff, and documented the condition of existing pump stations. Field visit notes and photos for each pump station facility are presented in **Appendix D** [TO FOLLOW]. All 13 pump stations boosting water to higher level pressure zones in the distribution system were visited and assessment of the condition of the facility was made. The assessment focused on the physical structure housing the mechanical and electrical systems, pumping systems, standby power availability, status and flow metering.

Each of these components was given a Condition rating ranging from 1 (very good) to 5 (very poor) and a Criticality rating ranging from 1 (not critical) to 4 (critical, pump station could not operate upon failure). Issues with each of the components were documented, and then the Condition and Criticality ratings were used to prioritize improvements to address identified issues. An additional rating, Serviceability, was identified as further criteria that the City could use to manage and prioritize the investment in these individual components at each station in the future. Where data was available to provide an assessment of Serviceability, the rating was included. City staff will input additional Serviceability ratings in the future as equipment is maintained and data can be gathered. Major issues noted at each pump station, based on a poor Condition rating and a high Criticality rating, include:

- **Madrone Pump Station** – structural review recommended to assess building settlement

- **Champion Pump Station** – isolation valves and control valves need replacement – Pumps 1 and 2
- **Lawnridge Pump Station**
    - structural review recommended for building
    - replace failing rubber bellows
    - install discharge isolation valving
- **New Hope Pump Station** – repair or replace inoperable exhaust fans
- **Multiple Stations** – repair or replace existing inoperable flow meters at six pump stations

Distribution Capacity and Hydraulic Performance

Hydraulic Model

A steady-state hydraulic network analysis model was used to evaluate the performance of the City's existing distribution system and identify proposed piping improvements based on hydraulic performance criteria, such as system pressure and flow velocity, described in **Section 3**. The purpose of the model is to determine pressure and flow relationships throughout the distribution system for average and peak water demands under existing and projected future conditions. Modeled pipes are shown as "links" between "nodes" which represent pipeline junctions or pipe size changes. Diameter, length and head loss coefficients are specified for each pipe and an approximate ground elevation is specified for each node.

The hydraulic model was developed prior to this WDSMP using the InfoWater modeling software platform and geographic information system (GIS) base mapping. Building on the facilities identified in the prior model and updated facility and operations data provided by the City, the model was then calibrated using fire hydrant flow test data and analysis scenarios were created to evaluate existing and projected 20-year demands.

For distribution system modeling, the City's WTP High Service Pump Station is assumed to be off. Distribution storage reservoirs are modeled at their approximate operational level, based on historical level data from the City's SCADA system and input from City staff. This is approximately 75 percent full for reservoirs serving Zones 1, 2 and 3 (Res. Nos. 3, 4, 5, 6, 8, 11). The Zone 4 Reservoir No. 13 is undersized such that it is constantly either filling or emptying; it is modeled as 90 percent full for this steady-state analysis. The North Valley Reservoir No. 15 is operated approximately 25 percent full due to low demand and water quality concerns.

Modeled Water Demands

Existing and projected future demands are summarized in **Section 2**, **Tables 2-2** and **2-6**. Within the existing water service area, demands are assigned to the model based on current customer billing address and billed water consumption. Future demands in water service

expansion areas are assigned uniformly over each proposed pressure zone area illustrated on the water system maps in **Appendix A**.

Model Calibration

Model calibration typically involves adjusting the model parameters such that pressure and flow results from the model more closely reflect those measured at the City's fire hydrants. This calibration process tests the accuracy of model pipeline friction factors, demand distribution, valve status, network configuration, and facility parameters such as tank elevations, PRV settings and pump controls and curves. The required level of model accuracy can vary according to the intended use of the model, the type and size of water system, the available data, and the way the system is controlled and operated. Pressure and flow measurements are recorded for the City's fire hydrants through a process called fire flow testing.

Fire Flow Testing

Fire flow testing consists of recording static pressure at a fire hydrant and then "stressing" the system by flowing an adjacent hydrant. While the adjacent hydrant is flowing, residual pressure is measured at the first hydrant to determine the pressure drop that occurs when the system is "stressed". Boundary condition data, such as reservoir levels and pump on/off status, must also be known to accurately model the system conditions during the time of the flow test. For this WDSMP, hydrant flow tests were conducted on May 13th and 14th, 2015. The recorded time of each fire hydrant flow test was used to collect boundary condition information from the City's supervisory control and data acquisition (SCADA) system.

Steady-State Calibration Results

For any water system, a portion of the data describing the distribution system will be missing or inaccurate and assumptions will be required. This does not necessarily mean the accuracy of the hydraulic model will be compromised. Depending on the accuracy and completeness of the available information, some pressure zones may achieve a higher degree of calibration than others. Models that do not meet the highest degree of calibration can still be useful for planning purposes.

Many of the City's smaller pressure zones are served through constant pressure pump stations. For the majority of these stations, accurate pump discharge flow measurements are not available. Some stations do not have flow meters, others are not functioning properly or they may be sized incorrectly to capture the range of flows at the station. The absence of accurate flow data for constant pressure zones makes it difficult to accurately model these facilities. Flows were approximated based on the assigned demands in the model, City-provided pump curves and discharge pressures measured at each station.

No flow tests were conducted in the PRV-controlled Zone 3B or in the constant pressure Harbeck (2HK), Hilltop (2HT) or Williams Crossing (3WX) zones. These zones serve a

small number of customers with little or no potential for future expansion; thus, the absence of flow testing data in these zones is not expected to impact the overall accuracy of the hydraulic model. No flow tests were conducted in the Meadow Wood high (3MW) zone due to insufficient existing hydrants in this largely undeveloped area. The calibration's confidence level was evaluated based on the difference between modeled and field-measured criteria summarized in **Table 4-5**.

Table 4-5
Calibration Confidence

Confidence Level	Static Pressure Difference	Residual Fire Flow Pressure Difference
High	±5 psi	≤10 psi
Medium	± 5-10 psi	10-20 psi
Low	>10 psi	>20 psi

Each existing pressure zone's overall confidence level was determined by the number of low-, medium- and high-confidence results, as summarized in **Table 4-6**. Overall system calibration confidence is considered moderate to low.

Table 4-6
Calibration Confidence Results

Pressure Zone	Overall Confidence
1	Medium
2	High
2A	Low
2HK	No Data
2HT	No Data
2NH	Low
2MW	Low
3	Medium
3B	No Data
3MW	No Data
3P	High
3S	Low
3WX	No Data
4	High
4LR	Medium
NV	Low

Fire Flow Analysis

Fire flow scenarios test the distribution system's ability to provide required fire flows at a given location while simultaneously supplying MDD and maintaining a minimum residual service pressure of 20 psi at all services. Required fire flows are assigned based on the zoning surrounding each node as summarized in **Section 3**, **Table 3-1**.

The City has invested in large diameter loops through developing commercial areas and smaller projects to complete additional looping for fire flow in residential areas. As a result, very few fire flow deficiencies were identified under existing and projected future MDD conditions.

Peak Hour Demand Analysis

Distribution system pressures were evaluated under peak hour demand conditions to confirm identified piping improvements. Peak hour demands were estimated as 1.7 times the maximum day demand. No additional pressure deficiencies were identified under these conditions.

Distribution Main Condition Assessment

Interviews were conducted with City staff to characterize the condition of the distribution system piping and identify any areas of concern. In order to provide for the continued reliable operation of the distribution system, renewal and replacement of distribution system piping must be planned for. With the exception of specific locations where significant corrosion and failure of mains are occurring, specifically north of Midland and west of 6th Street, the service life of pipelines have exceeded 60+ years. For the purposes of planning an annual budget for continued main replacement, it is recommended that the City consider a 100-year service life for mains. In order to maintain reliable operation, without significant unexpected main breaks and leaks, capital maintenance budgeting for the distribution system should be based on complete replacement every 100 years. While some mains may perform satisfactorily for a longer duration, others can be expected to fail in a shorter time frame, due primarily to environmental conditions.

Corrosion Issues

Based on discussions with City staff, there have been a number of main breaks affecting 10-inch diameter cast iron mains in Zones 2 and 3 along NW Midland Avenue, Morgan Lane and Vine Street. Previous work by the City indicates corrosive soils reacting with the pipe materials may be one cause of these issues. Severe corrosion recently led the City to replace a large section of stormwater piping in this area. Current development in this area is commercial and light industrial. The old Grants Pass Airport operated on a site between NW Vine Street and Morgan Lane from at least the early 1940s through approximately 1960. Due to recent main breaks, evidence of corrosive soils and the industrial history of the area, it is recommended that the City evaluate possible causes of main breaks including soil conditions

and pipe materials prior to proceeding with recommended CIP water main replacement projects described in **Section 5**.

Pressure Reducing Valve Stations

Four PRV stations in the City's water system were assessed as part of pump condition site visits in December 2015. Two of these stations - the 9th and Savage PRV and the Manzanita PRV – have significant issues, including:

- No vault drain (standing water was observed in both vaults)
- Unsecured square hatch
- No smaller diameter bypass valve

It is recommended that the City plan for the replacement of these two PRV stations.

Distribution System Water Quality

The City of Grants Pass meets all current drinking water regulations. The 2014 *Water Treatment Plant Facility Plan Update* presented a comprehensive review of current and future water quality compliance issues relating to the City's source and treatment facilities. This analysis focuses on microbial contaminants (Total Coliform Rule), lead and copper (Lead and Copper Rule) and disinfection by-products (Stage 2 Disinfectants and Disinfection Byproducts Rule) which may be exasperated or originate in the distribution system.

Total Coliform Rule Compliance

The City is currently meeting all applicable requirements for the Total Coliform Rule. It is important to maintain active circulation of water throughout the distribution system, in both pipes and reservoirs in order to retain a chlorine residual. The absence of chlorine residual and accumulation of sediments contribute to bacterial growth, which in turn can result in failure to comply with this rule.

The City has experienced challenges maintaining a detectable chlorine residual throughout the distribution system while also managing the presence of disinfection by-products, due primarily to high water age in the distribution system. High water age in the Grants Pass system is generally caused by the need to pump water through multiple pressure zones and storage reservoirs, to reach the highest elevation zones. Future improvements to the water treatment process which are planned for inclusion in the future replacement of the City's WTP will help to reduce the concentration of disinfection by-products and the chlorine demand of the finished water delivered to the distribution system. The City has taken further action and continues to improve methods to reduce water age, maintain adequate chlorine residuals and decrease distribution system chlorine demand, including:

1. Assessing implementation of an annual unidirectional flushing program (UDF) to reduce in-system chlorine demand. As part of this WDSMP project, a UDF pilot study will evaluate flushing program needs. The implementation of such a program requires up-front capital investment in development of the flushing plan and purchase of necessary equipment. On-going operational costs include budgeting for the staff required to perform the flushing operations on a routine basis.

2. Booster chlorination facilities have been installed at Lawnridge, Madrone and Champion Pump Stations to improve chlorine residual where high water age exists in these upper pressure zones. Recently the City has also improved automation of booster chlorination facilities at Lawnridge to allow for both flow pacing and chlorine residual monitoring feedback to accurately dose additional chlorine.

These steps have improved the City's ability to reliably maintain a detectable chlorine residual throughout the distribution system and have resulted in better management of disinfection by-products. At this time no further actions, beyond evaluation of a UDF program, are recommended to support continued compliance with the Revised Total Coliform Rule.

Lead and Copper Rule Compliance

The Grants Pass WTP has historically produced non-corrosive water, keeping the City in compliance with the Lead and Copper Rule since it was enacted in the early 1990s. There appears to be no concerns with future compliance with the Lead and Copper Rule.

Stage 2 Disinfectants and Disinfection Byproducts Rule (D/DBPR) Compliance

Currently, the City conducts quarterly sampling for DBP at the following four sample sites, all of which are currently in compliance:

- Merlin Landfill
- 1452 Forestview Drive
- New Hope Pump Station
- 1047 Starlite

Distribution System Hydropower Feasibility

Municipal drinking water systems present multiple opportunities for recovery of potential energy through the generation of hydroelectric power (hydropower). At any location where water is transmitted by gravity flow to a lower elevation location, potential energy exists in the system that is typically, and intentionally, lost through the use of a control valve (consuming the energy) or discharge to an un-pressurized state (releasing the energy), such as a distribution system reservoir. At locations where this potential energy exists, the energy may be recovered through the installation of hydropower generation facilities – a turbine and a generator. The quantity of electrical power that may be generated from this potential

energy depends on two primary factors, the flow rate of water and the available energy (the hydraulic head, or pressure).

Potential Hydropower Site Evaluation

In a municipal drinking water system, there are three primary opportunities for hydropower generation:

1. Water source
2. Transmission from treatment to the distribution system
3. Regulated connections between pressure zones

Water Source

Where a water system's source of supply is a gravity diversion (intake) located at a higher elevation than the WTP, the potential energy associated with the elevation difference is typically released in one of the initial steps in the water treatment process, in an un-pressurized basin (such as an initial sedimentation basin). Hydropower generation facilities may be installed to convert this excess energy to electrical power before it is released.

For the City of Grants Pass, the diversion of water at the Rogue River intake is pumped up from the river to the WTP, therefore there is no excess potential energy available for hydropower generation.

Transmission from the WTP to the Distribution System

In some drinking water systems, the WTP is located at an elevation higher than the distribution system, resulting in gravity transmission of water from the WTP to distribution system water storage reservoirs and customers. In this case, the excess potential energy is released at the reservoirs or consumed through a PRV, to prevent high pressure in the distribution mains from damaging distribution system components or customer fixtures. Hydropower generation facilities may be installed to convert this excess energy to electrical power before it is consumed or released.

In Grants Pass, the supply from the WTP to Zone 1, the lowest elevation pressure zone in the water system, is pumped up from the WTP. There is no excess potential energy available for hydropower generation at this location.

Regulated Pressure Zone Connections

Throughout a distribution system, there are typically a number of locations where a connection exists between a higher and lower elevation pressure zone. At these locations where water flows from the higher elevation zone to the lower elevation zone, a PRV is installed to consume the excess potential energy and prevent high pressure in the distribution mains from damaging distribution system components or customer fixtures. Hydropower

generation facilities may be installed to convert this excess energy to electrical power before it is consumed.

For the City, there are four locations where this condition exists and there may be potential for hydropower generation:

1. NW Starlite Place PRV (Zone 4LR to 3S)
2. NE Beacon Drive PRV (Zone 4 to 3B)
3. Manzanita PRV (Zone 2 to 2A)
4. 9th & Savage PRV (Zone 2 to 2A)

These four regulated pressure zone connections are each analyzed in the following paragraphs, including an initial assessment of other factors which may remove them from further consideration and an estimate of the annual hydropower generation capability.

NW Starlite Place PRV

This PRV station, installed in NW Starlite Place, connects two existing constant pressure zones, Zone 4LR (Laurel Ridge) and 3S (Starlite). The purpose of this regulated connection between zones is to provide redundant supply to each zone in the event that either of their respective pump stations are out of service. As such, flow through the PRV is intermittent which precludes the implementation of hydropower generation at this location.

NE Beacon Drive PRV

The PRV station, installed adjacent to the NE Beacon Drive right-of-way, connects Zone 4 to a small Zone 3B which serves approximately 7 existing residential services, with a future total of 13 residential services anticipated. The annual volume of water supplied through this PRV connection is approximately 0.82 MG and the available hydraulic head is approximately 150 feet. Annual hydropower generation potential at this location is approximately 560 kilowatt hours (kWh), assuming an overall system efficiency of 70 percent. At an assumed average value of $0.08 per kWh, the annual revenue from a hydropower generation facility at this location is approximately $45. As such, hydropower generation is not economically feasible at this location.

Manzanita PRV

This PRV station, located in a buried utility vault in the southwest corner of the intersection of NW Manzanita Avenue and NW Hawthorne Avenue, connects Zone 2 to Zone 2A. This is one of two locations where Zone 2A receives regulated supply from Zone 2. The other location is at 9th and Savage. The annual volume of water supplied through the two PRV connections is approximately 80 MG and the available hydraulic head is approximately 90 feet. Annual total hydropower generation potential between the two PRV locations is approximately 32,000 kWh. The annual revenue from hydropower generation facilities utilizing the total potential energy of supply to Zone 2A is approximately $2,563.20. Given

the low revenue potential and need to construct and operate facilities at both sites, hydropower generation is not economically feasible at either location.

9th & Savage PRV

This PRV station, located in a buried utility vault in the sidewalk on the northwest corner of the intersection of NE 9th Street and NE Savage Street, is the other location where water is supplied from Zone 2 to Zone 2A. As described above, hydropower generation is not feasible for the regulated supply between the two pressure zones.

Hydropower Feasibility Conclusions

Based on a review of the City's water system hydraulics and the assessment presented above, there are limited opportunities for implementation of hydropower generation. Three regulated connections between pressure zones in the distribution system provide the hydraulic and physical feasibility to generate hydropower but the conditions at these locations are not economically viable, primarily due to the low average rate of water supply through these PRVs resulting in electricity production that does not support the construction or operational costs of maintaining the facility and equipment.

Summary

This section presented an analysis of the City of Grants Pass's water distribution system based on projected future water demands presented in **Section 2** and performance criteria outlined in **Section 3**. This water system assessment includes service pressures and zone boundaries, storage and pumping capacity, facility condition and emergency fire flow availability. This section provides the basis for recommended distribution system improvements presented in **Section 5** Capital Improvement Program.

SECTION 5
RECOMMENDATIONS AND CAPITAL IMPROVEMENT PROGRAM (CIP)

This section presents recommended improvements and capital maintenance for the City of Grants Pass's (City's) water distribution system based on the analysis and findings presented in **Section 4**. These improvements include storage reservoir, pump station, pressure reducing valve (PRV) and water main projects. The capital improvement program (CIP) presented in **Table 5-4** later in this section summarizes recommended improvements and provides an approximate timeframe for project completion. Proposed distribution system improvements are illustrated on Plate 2 Proposed Water System Map in **Appendix A**.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended in this section. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering International (AACE) classifies cost estimates depending on project definition, end usage and other factors. The cost estimates presented here are considered Class 4 with an end use being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed.

Estimated project costs are based upon recent experience with construction costs for similar work in Oregon and southwest Washington and assume improvements will be accomplished by private contractors. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs. Estimates do not include the cost of property acquisition. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating; the current ENR CCI for Seattle, Washington is 10398 (July 2015).

Water System Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in **Table 5-4**. This CIP table provides for project sequencing by showing prioritized projects for the 5-year, 10-year and 20-year timeframes defined as follows:

- 5-year timeframe - recommended completion between 2016 and 2021
- 10-year timeframe - recommended completion between 2022 and 2026
- 20-year timeframe - recommended completion between 2027 and 2036.

CIP Cost Allocation to Growth

Water system improvement projects are recommended to mitigate existing system deficiencies and to provide capacity to accommodate growth and service area expansion. Projects that benefit future water system customers by providing capacity for growth may be funded through system development charges (SDCs). SDCs are sources of funding generated through development and water system growth and are typically used by utilities to support capital funding needs. SDCs are determined as part of a financial evaluation and are based in part on a utility's current CIP. To facilitate this financial evaluation a preliminary percentage of the cost of each project which benefits future water system growth is allocated in the CIP table. The basis for percentages allocated to growth are described later in this section for each recommended facility and summarized in the CIP **Table 5-4**.

All capital maintenance projects identified through the water facility condition assessment are considered water system performance improvements which benefit all customers. The estimated costs of these improvements are allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

CIP Funding

Subsequent to this Water Distribution System Master Plan (WDSMP), the City will be conducting a financial analysis in support of the water system CIP. The financial analysis, composed of a Water Rate Study and SDC Methodology, will be completed following the WDSMP.

Storage Reservoirs

Based on existing and projected future storage capacity deficiencies presented in **Section 4**, **Tables 4-2** and **4-3**, several new finished-water storage reservoirs are recommended. Communication infrastructure associated with proposed storage reservoirs must comply with the City's *2015 Water and Wastewater SCADA Systems Master Plan (Carollo)*.

Zone 4 Reservoir No. 13 Replacement (R-13)

A new 0.7 million gallon (MG) Ausland Reservoir (CIP No. R-13) is recommended to replace the existing undersized Zone 4 Reservoir No. 13. The proposed reservoir would supply existing customers in the Hillcrest neighborhood as well as potential future growth near Ausland and Scenic Drives and Spring Mountain Road. Due to access and site constraints at the existing Reservoir No. 13, it is recommended that the replacement reservoir be constructed on a City-owned site along Ausland Drive as illustrated on Plate 2 in **Appendix A**. Construction on this site would require significant transmission piping as well as a new Zone 4 Ausland Pump Station (CIP No. P-3) discussed later in this section.

Due to the existing storage deficit in Zone 4, the proposed reservoir is recommended for construction within the 5-year timeframe. Estimated project costs for proposed reservoir R-13 are allocated 40 percent to growth based on the ratio of existing to projected future storage capacity deficits in Zone 4.

Conversion from Constant Pressure to Gravity Service Zones (R-14, R-16, R-17)

New storage reservoirs are proposed in the established Laurel Ridge (4LR), Meadow Wood (2MW) and New Hope (2NH) areas to mitigate projected future capacity deficiencies and provide for anticipated zone expansion to serve new development. Each of these zones is currently served by a constant pressure pump station which does not have adequate redundant fire flow capacity. In lieu of upgrading the existing pump stations, it is recommended that storage reservoirs be constructed to serve these areas by gravity as growth exceeds the recommended 200 equivalent residential unit (ERU) maximum for constant pressure pumped zones. Each of these proposed reservoirs will serve both existing customers and future system expansion. Estimated project costs are allocated to growth as follows:

- R-14 Laurel Ridge Reservoir – 40 percent to growth
- R-16 Meadow Wood Reservoir – 69 percent to growth
- R-17 New Hope Reservoir – 42 percent to growth

These percentages are based on the ratio of storage capacity needed to serve existing customers and projected future storage needs at saturation development, which is also the recommended reservoir capacity.

Zone 2 Reservoir to serve Spalding Industrial Park (R-19)

The 1.2 MG Pearce Park Reservoir (CIP No. R-19) is proposed to serve the expansion of existing Zone 2 to potential future development in the Spalding Industrial area near the intersection of Redwood Highway (Hwy 199) and Interstate 5 (I-5). Estimated project costs for proposed reservoir R-19 are allocated 100 percent to growth as the reservoir is intended to serve potential future development.

Reservoir Capital Maintenance

Recent inspection of the structural condition of Reservoir Nos. 4, 6 and 11 identified concerns regarding the condition of these facilities. It is recommended that the City complete a full structural evaluation of all three reservoirs to determine the extent of repairs required to maintain these reservoirs in reliable service. The evaluation should include an analysis of each reservoir's expected performance in a seismic event. The estimated reservoir analysis capital maintenance cost is approximately $75,000.

Pump Stations

Based on the pumping capacity analysis presented in **Section 4**, **Table 4-4**, projects are recommended to increase capacity at existing pump stations and construct new stations to serve the City's growing service area. Communication infrastructure associated with proposed pump stations must comply with the City's *2015 Water and Wastewater SCADA Systems Master Plan (Carollo)*.

Fire Flow Capacity Upgrades (P-1 and P-2)

Upgrades are recommended at the existing Meadow Wood high (3MW) and Panoramic (3P) Pump Stations (CIP Nos. P-1 and P-2 respectively) to provide adequate, redundant fire flow capacity. Due to the existing pump capacity deficit in each zone, the proposed upgrades are recommended for construction within the 5-year timeframe. Projects P-1 and P-2 are considered water system performance improvements which benefit all customers through improved firefighting capacity. Their estimated costs are allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

Ausland Pump Station (P-3)

A new Ausland Pump Station (CIP No. P-3) is recommended to supply the proposed Ausland Reservoir (CIP No. R-13) from existing and proposed Zone 3 water mains on Scoville Road. These facilities will serve existing customers in the Hillcrest neighborhood and potential future development near Ausland and Scenic Drives and Spring Mountain Road. Pump station P-3 construction must coordinate with the Ausland Reservoir which is recommended within the 5-year timeframe to mitigate an existing storage deficiency in Zone 4. The estimated cost of project P-3 is allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development. The Ausland Reservoir, Pump Station and associated transmission improvements will allow the City to abandon Reservoir No. 13, Hefley Pump Station, and the Beacon Drive PRV, when completed.

Zone 4N Pump Station (P-4)

A new constant pressure pump station (CIP No. P-4) adjacent to the North Valley Reservoir No. 15 is recommended to serve potential future development along Highland Avenue between Morewood Lane and Pony Lane. This area is too high in elevation to be adequately served from existing adjacent North Valley transmission mains. Estimated project costs for proposed pump station P-4 are allocated 100 percent to growth as the station is intended to serve potential future development.

North Valley Pump Station Replacement (P-5)

Additional capacity is recommended at the existing North Valley Pump Station within the

10-year timeframe. Based on observations during the pump station condition assessment, it appears that capacity cannot be expanded within the existing pump station structure and control system. Thus it is recommended that the existing pump station be replaced with a larger facility to meet projected demands.

The recommended station firm capacity at saturation development is approximately 1,310 gpm, 740 gpm larger than the existing 570 gpm firm capacity at the North Valley Pump Station. The cost of the 740 gpm increase in capacity to serve future development is allocated 100 percent to growth. The cost of the 570 gpm replacement capacity at the proposed pump station is considered a water system performance improvement; the cost of which is allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

As discussed in **Section 2**, projected water demands in the North Valley service area are heavily influenced by future development in the proposed Paradise Ranch Resort, thus timing and capacity needs for this pump station replacement should be re-evaluated as development occurs.

Pump Station Capital Maintenance

Based on the condition assessment previously described in **Section 4**, **Table 5-1** summarizes the major issues noted at each pump station, based on a poor Condition rating and a high Criticality rating. This table also provides an estimate of the cost to complete the recommended repairs or actions. A summary of the Condition, Criticality and Serviceability rating for each component, as well as notes regarding the station assessment and identified issues, is presented in **Appendix D** [TO FOLLOW].

Table 5-1
Pump Station Condition Issues Summary

Pump Station	Component	Issue	Estimated Capital Cost
Madrone	Structure	Structural review recommended to assess building settlement	$20,000
Champion	Miscellaneous	Isolation valves and pump control valves need replacement – Pumps 1 and 2	$25,000
Lawnridge	Structure	Structural review recommended for building	$20,000
	Miscellaneous	Replace failing rubber bellows and install discharge isolation valving	$12,000
New Hope	Miscellaneous	Repair/replace inoperable exhaust fans	$3,000
Multiple	Flow meters	Existing flow meter is inoperable at 6 stations. Repair or replace.	$45,000
Total Estimated Pump Station Capital Maintenance Cost			**$125,000**

Pressure Reducing Valves (PRVs)

Future Distribution Looping between Pressure Zones (V-1, V-2, V-3, V-4, V-6)

PRVs are recommended to provide looping between pressure zones in areas of potential future development including the Spalding Industrial area, Highland Avenue north of Vine Street, Blue Gulch and Fruitdale. Estimated project costs for proposed PRVs V-1, V-2, V-3, V-4 and V-6 are allocated 100 percent to growth as these valve stations are intended to serve potential future development.

10th Street Zone 2 Fire Flow Improvement (V-5)

A new PRV is recommended to provide improved fire flow to multi-family housing along NE 10th Street south of NE Hillcrest Drive. The proposed 10th Street PRV (CIP No. V-5) would supply water from proposed higher pressure zone mains to Zone 2 fire hydrants in the event of an emergency. There are no existing water mains on this portion of NE 10th Street or NE Hillcrest Drive. Construction of this project must be coordinated with Zone 4 mains on NE Hillcrest Drive (CIP No. M-40) proposed for construction within the 5-year timeframe and future Zone 3 mains (CIP No. M-33). Project V-5 is considered a water system performance improvement which benefit all customers through improved firefighting capacity. The estimated cost of this improvement is allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

PRV Capital Maintenance – replace Zone 2A PRVs (V-7)

The existing Zone 2A PRVs, 9th & Savage and Manzanita, are recommended for replacement as part of the City's capital maintenance program. These valves are the only supply source for customers in Zone 2A thus they are recommended for replacement within the 5-year timeframe.

Distribution Mains

Table 5-4 presents recommended water main projects for fire flow capacity and system expansion, grouped by service area. This summary table includes estimated project costs and preliminary percent cost allocations to future growth. Detail tables by timeframe for all water main improvements are presented in **Appendix E**. All recommended water main projects are illustrated on Plate 2 in **Appendix A**.

Distribution Main Cost Estimates

Water main project costs are estimated based on unit costs by diameter shown in **Table 5-2**.

Table 5-2
Unit Cost for Water Main Projects

Pipe Diameter	Cost per Linear Foot ($/LF)
8-inch	$240
12-inch	$280
16-inch	$350

Assumptions:

1. Includes approximately 45 percent allowance for administrative, engineering and other project related costs
2. Ductile iron pipe with an allowance for fittings, valves and services
3. Surface restoration is assumed to be asphalt paving
4. No rock excavation
5. No dewatering
6. No property or easement acquisitions
7. No specialty construction included, cost estimates for proposed water main projects using trenchless construction methods are described later in this section

Trenchless Construction Costs

The recommended CIP presented in **Table 5-4** includes water main projects which involve crossing the I-5 freeway. These projects must be completed using trenchless construction methods, such as, auger boring. Cost estimates for these projects are developed based on MSA's recent experience with 12-inch diameter and larger trenchless water main construction in Oregon and southwest Washington. Estimates are calculated based on the following:

- Assume bore pits at each end of trenchless alignment, approximate planning-level project cost at $1,500 per foot of excavated depth, allow 2 feet of depth under casing for equipment

- Steel casing with ductile iron carrier pipe, approximate planning-level project cost at $40 per inch diameter per LF based on casing diameter
    - 12-inch main (carrier pipe) with 24-inch casing = $960/LF
    - 16-inch main (carrier pipe) with 36-inch casing = $1,440/LF

Water Mains to Improve Fire Flow and System Looping
(M-1 to M-10, M-34 to M-41, M-45, M-46, M-52, M-78 to M-80)

As presented in **Section 4**, analysis using the City's water system hydraulic model revealed that minimal piping improvements are needed to provide sufficient fire flow capacity and adequate service pressure within the existing water service area under existing and projected future demand conditions. These water main projects are considered water system performance improvements which benefit all customers. Their estimated costs are allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

10th Street Zone 2 Fire Flow Improvement (M-9 and M-10)

New 8-inch water mains (CIP No. M-9, M-10) and a PRV (CIP No. V-5) are recommended to provide improved fire flow to multi-family housing along NE 10th Street south of NE Hillcrest Drive. The proposed 10th Street mains would supply water from proposed higher pressure zone mains on Hillcrest to Zone 2 fire hydrants in the event of an emergency. There are no existing water mains on this portion of NE 10th Street or NE Hillcrest Drive. Construction of this project must be coordinated with Zone 4 mains on NE Hillcrest Drive (CIP No. M-40) proposed for construction within the 5-year timeframe and future Zone 3 mains (CIP No. M-33) also on Hillcrest. Projects M-9 and M-10 are considered water system performance improvements which benefit all customers through improved firefighting capacity. Their estimated costs are allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

Ausland Pump Station and Reservoir Mains (M-34 to M-41, M-52)

New 12-inch water mains are needed to connect the proposed Ausland Pump Station (CIP No. P-3) and Ausland Reservoir (CIP No. R-13) to existing Zone 4 customers in the Hillcrest neighborhood. Reservoir R-13 is proposed within the 5-year timeframe to replace the undersized Zone 4 Reservoir No. 13. These water mains (CIP No. M-34 to M-41, M-52) are considered water system performance improvements which benefit all customers. Their estimated costs are allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

As the City plans for construction of the Zone 4 I-5 crossing at Cedar Loop (CIP No. M-52) it is recommended that City staff evaluate potential cost savings from installing the parallel Zone 3 pipe casing (CIP No. M-32) at the same time. Both mains are assumed to be installed using trenchless techniques, some economy may be gained by constructing a single bore pit at each end of the alignment to accommodate both casings.

Projects for Future System Expansion (M-13 to 33, M-42 to 51, M-53 to 77, M-81 to 83)

Large diameter distribution main loops are needed to serve partially developed or undeveloped areas within the City's Urban Growth Boundary (UGB) including the Meadow Wood high (3MW), New Hope (2NH) and Blue Gulch (3BG) areas. Future water facilities to serve proposed Zone 2H combining the Harbeck and Hilltop zones are discussed in more detail in **Appendix C** along with proposed facilities for Zone 4N, Spalding Industrial area and Zone 3 and 4 north of I-5. Although many of these piping improvements will be constructed only as development warrants it is prudent for the City to have a long-term plan which sizes proposed facilities for the ultimate anticipated capacity need. Costs for water main projects recommended to facilitate water system expansion are allocated 100 percent to growth.

Distribution Capital Maintenance - Routine Main Replacement Program

In addition to distribution main projects to address capacity deficiencies, the City should plan for replacement of pipes based on a 100-year life cycle in order to maintain reliable operation, without significant unexpected main breaks and leaks. **Table 5-3** summarizes the total length of pipe for each diameter (size), the replacement diameter and estimated cost to replace all of the mains of that size. While costs will vary for each individual main depending on the piping location, surface conditions, and other constructability issues, this analysis provides a preliminary estimate of the required capital budget to execute an effective and proactive water main replacement program.

The capital maintenance cost for routine main replacement included in this plan is based on the average annual cost for the first 20 years of a 100-year program, approximately $1.6 million annually. While it is understood that funding at this level for pipeline replacement may not be feasible, it should be recognized that an adequately funded main replacement program is necessary to minimize the risk of failure for critical water system components that will result in significantly greater costs to repair and replace in the future.

Table 5-3
Distribution Main Replacement Cost Summary

Diameter (in)	Approx. Length (miles)	Replacement Diameter (in.)	Estimated Replacement Cost
2	5.3	8	$88,000,000
3	0.05		
4	3.0		
6	44.3		
8	77.1		
10	8.1	12	$45,000,000
12	36.1		
14	0.4	16	$16,000,000
16	11.7		
20	3.6	20	$6,000,000
24	1.0	24	$2,000,000
30	1.0	30	$3,000,000
36	0.01	N/A	N/A
Total Length	**191.7**	**Total Cost**	**$160,000,000**

Total 20-year Main Replacement Capital Maintenance Cost: $32,000,000

Planning

A water system seismic resilience study for the City is recommended in the next one to five years. The study is intended to identify system vulnerabilities and work towards developing a plan to meet seismic response and recovery goals for water utilities presented in the Oregon Resilience Plan.

It is recommended that the City update this Water Distribution System Master Plan within the next 10 to 20 years. An update may be needed sooner if there are significant changes to the City's water service area, supply or distribution system which are not currently anticipated.

To comply with Oregon Water Resources Department (OWRD) requirements for surface water permit holders Grants Pass is required to complete an update of their Water Management and Conservation Plan (WMCP) every 10 years. The next update of the City's WMCP is expected to begin in 2022.

A water distribution piping corrosion study is recommended within the next 5 years to identify potential pipe materials and installation methods required to minimize corrosion risks in areas where corrosive soils may exist. This study will also provide recommendations

for mitigating water main corrosion to extend the life of existing water mains. The timely completion of this study will help the City maximize the life of the distribution system and may reduce the annual capital needs of the Routine Main Replacement Program in the future.

As discussed in Section 4, the City should plan for the implementation of a unidirectional flushing (UDF) program. As part of this WDSMP, a pilot UDF program was developed and tested for Zone 2B. Based on this pilot testing, a recommended budget of $XXX,XXX [TO FOLLOW] is included in the 5-year timeframe of the CIP.

Future water system planning projects are considered water system performance improvements which benefit all customers. Their estimated costs are allocated 52 percent to future growth based on the ratio of current to projected future system-wide maximum day demands at saturation development.

Summary

This section presented recommendations for improvement, expansion and capital maintenance projects in the City's water distribution system. As presented in **Table 5-4**, the total estimated cost of these projects is approximately $77.8 million through 2036. Approximately $38.1 million of the total estimated cost is for projects needed within the 10-year timeframe and $16.4 million of these improvements are required in the next 5 years.

Table 5-4
Capital Improvement Program (CIP) Summary

Improvement Category	CIP No.	Project Description	CIP Schedule and Project Cost Summary				Preliminary Cost % to Growth
			5-year thru 2021	10-year 2022-2026	20-year 2027-2036	Estimated Project Cost	
Storage Reservoirs	R-13	0.7 MG Ausland Reservoir - Zone 4 Reservoir No. 13 replacement	$ 2,100,000			$ 2,100,000	40%
	R-14	0.5 MG Laurel Ridge Reservoir			$ 1,500,000	$ 1,500,000	40%
	R-16	1.3 MG Meadow Wood Reservoir		$ 3,900,000		$ 3,900,000	69%
	R-17	1.2 MG New Hope (Cathedral Hills) Reservoir		$ 3,600,000		$ 3,600,000	42%
	R-19	1.2 MG Pearce Park Reservoir - Zone 2 Spalding Industrial Park			$ 3,600,000	$ 3,600,000	100%
		Capital Maintenance	$ 75,000			$ 75,000	52%
		Subtotal	$ 2,175,000	$ 7,500,000	$ 5,100,000	$ 14,775,000	$ 9,282,000
Pump Stations	P-1	Meadow Wood P.S. high (Zone 3MW) - fire flow capacity upgrade	$ 250,000			$ 250,000	52%
	P-2	Panoramic P.S. - fire flow capcity upgrade	$ 400,000			$ 400,000	52%
	P-3	Ausland P.S. supplying proposed Ausland Reservoir (R-13)	$ 500,000			$ 500,000	52%
	P-4	Zone 4N P.S. - constant pressure			$ 1,200,000	$ 1,200,000	100%
	P-5	North Valley P.S. replacement		$ 1,000,000		$ 1,000,000	79%
		Capital Maintenance	$ 125,000			$ 125,000	52%
		Subtotal	$ 1,275,000	$ 1,000,000	$ 1,200,000	$ 3,475,000	$ 2,654,145
PRVs	V-1	Spalding Industrial Area - Ament Rd PRV			$ 150,000	$ 150,000	100%
	V-2	Zone 4N Highland Ave PRV			$ 150,000	$ 150,000	100%
	V-3	Blue Gulch PRV			$ 150,000	$ 150,000	100%
	V-4	Overland PRV			$ 150,000	$ 150,000	100%
	V-5	10th Street PRV	$ 150,000			$ 150,000	52%
	V-6	NW B Street PRV			$ 150,000	$ 150,000	100%
	V-7	Zone 2A PRV replacements (Capital Maintenance)	$ 250,000			$ 250,000	52%
		Subtotal	$ 400,000	$ -	$ 750,000	$ 1,150,000	$ 958,000
Distribution Mains	M-1, 2, 3, 9, 10	Piping improvements for fire flow	$ 683,000			$ 683,000	52%
	M-4 to 8	Zone 2A - Hwy 99, Savage, Manzanita Loop	$ 758,000			$ 758,000	52%
	M-11, 12	Proposed Zone 2H - connect Harbeck and Hilltop			$ 532,000	$ 532,000	100%
	M-13 to 22	Spalding Industrial Area - Zone 2 expansion			$ 3,181,000	$ 3,181,000	100%
	M-24, 25, 26	Zone 3 Granite Hill to Scoville Loop			$ 1,415,000	$ 1,415,000	100%
	M-27 to 30	Zone 3 Scoville to Spring Moutain Loop			$ 1,107,000	$ 1,107,000	100%
	M-31 to 33, 42	Zone 3 I-5 crossing at Cedar Loop, Spring Moutain to Hillcrest Loop			$ 1,396,000	$ 1,396,000	100%
	M-34 to 41, 52	Proposed Ausland P.S. (P-3) and Reservoir (R-13) mains	$ 2,897,000			$ 2,897,000	52%
	M-43, 44	Zone 3 I-5 crossing at Humane Society			$ 570,000	$ 570,000	100%
	M-45, 46	Zone 3 Vine Street Loop - Highland to Hawthorne			$ 996,000	$ 996,000	52%
	M-47 to 51	Zone 4N mains			$ 1,996,000	$ 1,996,000	100%
	M-53 to M-57	Zone 1 Spalding Industrial Area loop			$ 1,362,000	$ 1,362,000	100%
	M-58 to 62	Meadow Wood future mains		$ 1,173,000		$ 1,173,000	100%
	M-63 to 68	New Hope future mains		$ 2,532,000		$ 2,532,000	100%
	M-69 to 75	Laurel Ridge and Blue Gulch future mains			$ 1,870,000	$ 1,870,000	100%
	M-76, 77, 81, 82, 83	Zone 1 Fruitdale future mains			$ 2,087,000	$ 2,087,000	100%
	M-78, 79, 80	Zone 1 Looping- Cloverlawn & Grandview		$ 639,000		$ 639,000	52%
	M-84 to 87	Zone 1 Lincoln Road Loop		$ 814,000		$ 814,000	52%
		Routine Main Replacement Program (Capital Maint.)	$ 8,000,000	$ 8,000,000	$ 16,000,000	$ 32,000,000	52%
		Subtotal	$12,338,000	$13,158,000	$ 32,512,000	$ 58,008,000	$ 39,390,240
Planning		Seismic Resilience Study	$ 100,000			$ 100,000	52%
		Water Management & Conservation Plan update		$ 50,000		$ 50,000	52%
		Water Distribution System Master Plan update			$ 150,000	$ 150,000	52%
		Unidirectional Flushing (UDF) Program Development	$TBD			$ -	52%
		Distribution Piping Corrosion Study	$ 100,000			$ 100,000	52%
		Subtotal	$ 200,000	$ 50,000	$ 150,000	$ 400,000	$ 208,000
Capital Improvement Program (CIP) Total			**$16,388,000**	**$21,708,000**	**$ 39,712,000**	**$ 77,808,000**	**$ 52,492,385**

Annual Average CIP Cost		
$3,277,600	**$3,809,600**	**$3,890,400**
5-year	**10-year**	**20-year**